Aqualon® polymers
for personal care

rheology and conditioning solutions

Aqualon

ASHLAND

Polymers for personal care

	Hair Care					Cosmetics	
	Clarifying Shampoo	2-in-1 Shampoo	Conditioner	Styling Gel	Styling Mousse	Liquid Makeup	Mascara
Natrosol® hydroxyethylcellulose (HEC)	**250 HHR or HR 0.5-1.0% Clarity, Rheology**	250 HHR or HR 0.5-1.0% Rheology	**250 HHR or HR 0.5-1.0% Rheology**	250 HHR or HR 0.5-1.0% Clarity, Rheology	**250 HHR or HR 0.5% Foam Stabilizer**		
Aqualon® sodium carboxymethylcellulose (CMC)	9M31XF 0.5-1.0% Foam Stabilizer					**7H4XF 0.5% Suspension Stability**	**7H4XF 0.5% Suspension, Binder**
Klucel® hydroxypropylcellulose (HPC)				E CS 0.5% Film Former, Soft Feel			E CS or L CS 1.0% Film Former
Natrosol® *Plus* and ***PolySurf®*** cetyl hydroxyethylcellulose (HMHEC)		NP 330 CS or PS 67 0.5-1.0% Rheology	NP 330 CS or PS 67 0.5-1.0% Rheology		NP 330 CS 0.25-1.0% Mild Surfactant	NP 330 CS 0.5% Suspension Stability	NP 330 CS 0.5% Suspension Emulsion Stability
Benecel® methylcellulose and hydroxypropyl methylcellulose (MC and HPMC)	F4M C, K100M, K200M, E10M 0.5-1.0% Rheology	F4M C, K100M, K200M, E10M 0.5-1.0% Rheology			K100M, K200M, E10M 0.5% Foam Stabilizer		
PrimaFlo® HP22 HPC solution				**HP22 2.0-3.0% Film Former, Soft Feel**			
N-Hance® HP Series hydroxypropyl guar		HP-40S 0.5-1.0% Lubricity, Lather Richness	HP-40S 0.5-1.0% Lubricity		HP-40S 0.5-1.0% Foam Stability, Dry Feel		
N-Hance® 3000 Series, N-Hance® CG Series , N-Hance BF Series and **N-Hance HPCG Series** cationic guar		**3000, 3196, 3215, CG/BF 13, CCG 45, CCG 450 0.2-0.5% Conditioning**	**3000, 3196, 3215, CG/BF 13, CCG 45, CCG 450 0.2-0.5% Conditioning**		**3000, 3196, 3215, CG/BF 13, CCG 45, CCG 450 0.25-0.5% Conditioning**		
AquaCat® clear cationic solution		**iC 2.0-4.0% Conditioning With Clarity**	CG518 2.0-4.0% Conditioning With Clarity	iC 2.0-4.0% Conditioning and Soft Feel	iC 2.0-4.0% Conditioning and Soft Feel		
Supercol® guar gum			**U 0.5-1.5% Conditioning**				
N-Hance® SP Series Synthetic Conditioning Polymer		N-Hance SP-100 0.2%	N-Hance SP-100 1.0%	N-Hance SP-100 3.0%	N-Hance SP-100 3.0%		

Most commonly specified products are highlighted in **bold**.

	Oral Care							
Facial Masques	Clear Gel Toothpaste	Cream Toothpaste	Liquid Toothpaste	Sensitive Teeth Cream Toothpaste	Baking Soda Cream Toothpaste	Baking Soda Gel Toothpaste	Powder Denture Adhesive	Cream Denture Adhesive
	250 M or HX 1.5% Nonionic Binder, Anti-Syneresis	250 M or HX 1.5% Nonionic Binder, Anti-Syneresis		**250 M or HX 1.5% Nonionic Binder, Anti-Syneresis**	250 M or HX 1.5% Nonionic Binder, Anti-Syneresis	250 M or HX 1.5% Nonionic Binder, Anti-Syneresis		
7H4XF 1.0-5.0% Rheology	**9M31XF or 12M31XP 0.25-0.50% Rheology, Anti-Syneresis**	**7MF, 9M31F or 12M31P 0.4-1.4% Rheology, Anti-Syneresis**	**7MXF 0.5-1.0% Rheology**	9M31F or 12M31P 0.4-1.4 Rheology, Anti-Syneresis	**9M31F or12M31P 0.4-1.4% Rheology, Anti-Syneresis**	**9M31F or12M31P 0.25-0.50% Rheology, Anti-Syneresis**	**7H3SXF 66% Wet tack**	**7H3SXF 33% Binder, Wet Tack**
E CS or L CS 0.5% Flexible Film Former								

Polymers for personal care

	Skin Care, Cleansing, a					
	Bubble Bath	**Liquid Hand Soap**	**O/W Emulsions for Skin Care**	**Hydro-Alcoholic Gels**	**Topical Gels and Ointments, Aqueous**	**Low pH Skin Creams**
Natrosol® hydroxyethylcellulose (HEC)	**250 HHR or HR 0.5% Foam Stabilizer**	**250 HHR or HR 0.5-1.0% Clarity, Rheology**	250 HHR or HR 0.5-1.0% Clarity, Rheology	250 MR 0.5-1.0% Clarity, Rheology	**250 HHR, HR or H NF 1.0-2.0% Clarity, Lubricity**	250 HR or MR 0.5-1.0% Clarity, Rheology
Aqualon® sodium carboxymethylcellulose (CMC)					7H3SF 1.0-2.0% Rheology, Clarity	
Klucel® hydroxypropylcellulose (HPC)				**M CS or H CS 1.0% Rheology, Clarity, Film Forming**	M CS or H CS 1.0-2.0% Rheology, Clarity	
Natrosol® *Plus* and ***PolySurf®*** cetyl hydroxyethylcellulose (HMHEC)	NP 330 CS or PS 67 0.5-1.0% Mild Surfactant	**NP 330 CS 0.25-0.50% Rheology, Anti-Drip**	**NP 330 CS or PS 67 0.25-1.0% Rheology, Co-Emulsifier**			**NP 330 CS or PS 67 0.25-1.0% Rheology**
Benecel® methylcellulose and hydroxypropyl methylcellulose (MC and HPMC)	F4M C 0.5% Foam Stabilizer					
PrimaFlo® HP22 HPC solution						
N-Hance® HP Series hydroxypropyl guar			HP-40S 1.0% Lubricity, Richness		HP-40S 1.0-2.0% Lubricity, Richness	
N-Hance® 3000 Series, N-Hance® CG Series , N-Hance BF Series and **N-Hance HPCG Series** cationic guar		**3000, 3196, 3215, CG13, CCG 45, CCG 450 0.2-0.5% Conditioning**	3196, 3215, CG13, CCG 45, CCG 450, 0.25% Conditioning			
AquaCat® clear cationic solution	PF 618 2.0-4.0% Conditioning With Clarity	**CG 518 2.0-4.0% Conditioning With Clarity**				
Supercol® guar gum		U 0.5-1.5% Conditioning				
N-Hance® SP Series synthetic condiitoning polymers						

Most commonly specified products are highlighted in **bold**.

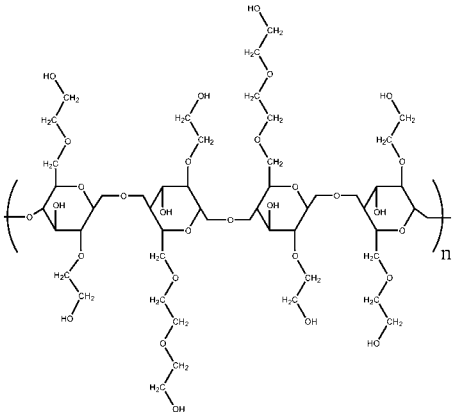
nd Bathing					
Shave Gels	Antiperspirant Roll-On Liquid	Antiperspirant Gel Stick	Anhydrous Systems	Body Wash	Wet Wipes for Baby and Adults
250 HHR or HR 1.0% Rheology	250 HHR, HR or MR 0.2-1.0% Rheology		250 H 1.0% Rheology	250 HHR or HR 1.0% Rheology	250 HHR or HR 1.0% Lubricity, Rheology
M CS or H CS 1.0% Rheology, Clarity, Lubricity			**All Types 0.5-2.0% Rheology, Clarity**		
NP 330 CS or PS 67 0.5 -1.0% Rheology		PS 67 0.5-1.5% Rheology, Co-Gelling Agent	NP 330 CS 0.5-1.0% Rheology	NP 330 CS or PS 67 0.5-1.0% Rheology	**NP 330CS or PS67 0.5-1.0% Lubricity, Suspension**
				F4M C 1.0% Foam Booster	
HP-40S 1.0-2.0% Lubricity, Richness					HP-40S 0.25-0.5% Lubricity, Richness
3000, 3196, 3215 CCG 45, CCG 450 0.5% Conditioning				**HPCG 1000 0.2 - 1.0% Conditioning**	3000, 3196, 3215 CCG 45, CCG 450 0.25-0.5% Conditioning
CG518 2.0-4.0% Conditioning and Clarity				**CG 518 2.0-4.0% Conditioning With Clarity**	PF 618 2.0-4.0% Conditioning

Natrosol® hydroxyethylcellulose

INCI Name: Hydroxyethylcellulose

Natrosol 250 hydroxyethylcellulose (HEC), a nonionic, water-soluble polymer is a white, free-flowing granular powder. It is made by reacting ethylene oxide with alkali-cellulose under rigidly controlled conditions. Purified HEC for personal care and cosmetic applications is typically sold at 96.0% minimum purity (dry basis). Pharmaceutical (PHARM) grades are of higher purity.

Figure 1– Idealized Chemical Structure of Natrosol HEC With Degree of Substitution (DS) = 2.0 and Molar Substitution (MS) = 2.5



Natrosol HEC is easily dissolved in cold or hot water to give crystal clear solutions of varying viscosities. Furthermore, low to medium molecular weight (MW) types are fully soluble in glycerol and have good solubility in hydro-alcoholic systems containing up to 60% ethanol. Natrosol HEC is generally insoluble in organic solvents.

Typical Applications in Personal Care

Natrosol HEC is commonly used in a wide variety of applications in the personal care and medical industries. Some of the more common applications are as follows:

- Hair conditioner
- Shave gels and foams
- Wipes (baby and adult)
- AP/Deodorant solids
- Liquid soaps
- Toothpaste (high salt)
- Makeup/mascara
- Lubricant gels

Solutions of Natrosol HEC are pseudoplastic or shear-thinning. As a result, personal care products formulated with Natrosol HEC dispense rich and thick from the container, but spread easily on hair and skin.

Product Coding and Nomenclature

Each specific grade of Natrosol HEC is designated by a product type, beginning with 250, which indicates an average molar substitution of 2.5 (5 ethylene oxide groups per 2 anhydroglucose units, as illustrated in Figure 1). This is followed by an indication of viscosity/molecular weight type and other designators.

Example 1: Natrosol 250 **MBR CS**

M Means medium MW
B Means biostable
R Means treated for retarded hydration
CS Means cosmetic grade

Percent Solutions

Type	1%	2%	5%
HHR CS	3,400-5,000		
HHX PHARM	3,500-5,500		
HR CS	1,500-2,500		
HX PHARM	1,500-2,500		
H PHARM	1,500-2,500		
MBR CS		4,500-6,500	
MR CS		4,500-6,500	
M PHARM		4,500-6,500	
G PHARM		250-400	
L PHARM			75-150

B Grades

Certain medium and high viscosity types of Natrosol HEC are available in a grade that has superior biostability in solution (designated by the letter "B" in the product type). These grades are manufactured under modified conditions to produce an HEC that is much more stable in water containing cellulase enzyme. Process water containing cellulase enzyme is common in tropical locations, but less common in developed northern regions (such as North America and Europe). The presence of cellulase enzyme in a formulation containing HEC will cause the formulation to lose viscosity over time.

R Grades

Cosmetic grades of Natrosol HEC are typically surface treated with a pH sensitive coating to prevent the tendency to lump, or agglomerate, upon introduction to water. Grades so treated are designated by the letter "R" for retarded hydration.

Typical Properties of Natrosol 250 HEC

Polymer Properties

Purity, dry basis, %, minimum.....96.0
Moisture content (as packed), %, maximum.....5.0
Browning range, °F (°C).....401-410 (205-210)
Softening range, °F (°C).....275-284 (135-140)
Bulk density, g/ml.....0.6
Biological oxygen demand, ppm
H Types.....7,000
L Types.....18,000

Solutions

pH, 2% solution.....7.0
Surface tension, 0.1% solution, dynes/cm.....66.8
Specific gravity, 2% solution.....1.0033
Refractive index, 2% solution.....1.336

Salt Tolerance

Since Natrosol HEC is a nonionic polymer, readily soluble in aqueous systems, it exhibits excellent salt tolerance in personal care formulations. Sample formulations containing up to 20% salt have been successfully demonstrated.

Techniques for Dispersion and Dissolution

Natrosol HEC grades that have been R-treated exhibit a hydration time–time that is required for thickening to begin after addition to water. Hydration time depends strongly on water temperature and pH (Figure 3). Cold, acidic water will provide the longest hydration delay.

To prepare lump-free solutions, R-treated grades of Natrosol HEC should be added to agitated water at pH 7.0 or lower. After the Natrosol HEC particles are fully dispersed, the pH should be increased to pH 8.5 or higher.

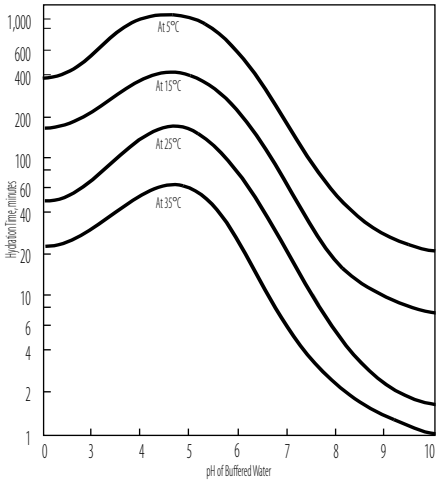


Figure 3– Effect of pH and Temperature on the Hydration Time of Natrosol R Grades

Microbiological Info and Regulatory Status

Ashland Aqualon Functional Ingredients facilities for hydroxyethylcellulose production are operated in compliance with Current Good Manufacturing Practice Regulations (CGMPR) as promulgated in the U.S. Code of Federal Regulations. While extreme care is exercised at every process step and the product is of excellent microbiological quality, HEC is not marketed as a sterile material; therefore, we recommend that our customers control the microbiological quality of their finished product through the application of appropriate process and formulation expertise.

Natrosol HEC is routinely sampled and subjected to microbiological testing by an independent laboratory and data are tabulated to provide an ongoing indicator of control in production. The data generated are not intended to be used to provide product specifications, but typical results obtained using our standard protocol, are shown below:

Aerobic plate count, cfu/g.....<100
Mold, cfu/g.....<100
Yeast, cfu/g.....<100
Coliforms, MPN/g.....<30
E. coli / 10 g.....negative
Staphylococcus aureus / 10 g.....negative
Salmonella / 25 g.....negative
Pseudomonas / 10 g.....negative

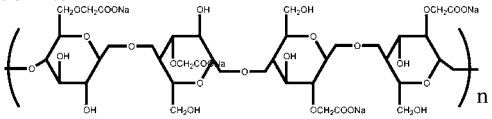
Ashland Aqualon Functional Ingredients utilizes official approved methods to determine the above microbial parameters, but recommends that users of Natrosol HEC assure themselves of compliance with any microbiological criterion by testing each lot.

Aqualon® and Blanose® sodium carboxymethylcellulose

INCI Name: Cellulose Gum

Sodium carboxymethylcellulose (CMC) is made by reacting sodium monochloroacetate with alkali-cellulose under rigidly controlled conditions. The resultant anionic polymer is purified and dried. Purified CMC for personal care and cosmetic applications meets all requirements of various food and pharmaceutical monographs.

Figure 1– Idealized Chemical Structure of CMC with a DS = 1.0



Typical Applications in Personal Care

CMC is commonly used in a wide variety of applications in the personal care and medical industries. Some of the more common applications are as follows:

- Toothpaste
- Denture adhesive
- Liquid makeup and mascara
- Hair dye powder
- Hydrocolloid wound care
- Ostomy products
- Liquid suspensions
- Gels and ointments

In addition to thickening aqueous systems, CMC is used in these products for water binding, syneresis control, and its ability to suspend pigments and active ingredients in solution.

Product Coding and Nomenclature

Each specific grade of CMC is designated by a product type which indicates physical and chemical composition. The first number indicates degree of substitution (DS) x 10, followed by a molecular weight range designation, then solution types, particle size designation and finally, regulatory conformance.

An example is Aqualon CMC **7H3SXF PH**:

7 Means nominal DS of 0.7

H3 Means high viscosity

S Means "smooth" solution appearance

X Means fine grind (can also be "C" for coarse)

F Means food grade

PH Means USP, EP and JP Pharmaceutical compliant (for 12-types, typically designated by a "P" in place of "F")

Degree of Substitution and Molecular Weight

Physical and solution properties of CMC can be varied though manipulation of the DS and molecular weight. CMC is typically offered in three different DS ranges and a broad range of molecular weights.

CMC Type	Nominal DS	Substitution Range	Sodium Content, %
7	0.7	0.65-0.90	7.0-8.9
7S	0.7	0.65-0.95	7.0-9.2
9	0.9	0.80-0.95	8.1-9.2
12	1.2	1.15-1.45	10.5-12.0

Solution Viscosities at 25°C		Substitution Types		
% Solution	Viscosity Range, cps	"7" Types	"9" Types	"12" Types
1%	2,500-6,000	7H4	9H4	
1%	1,000-2,800	7H3S, 7HOF		
1%	1,500-3,000	7H		
2%	1,500-3,100		9M31	
2%	800-3,100			12M31
2%	400-800	7M	9M8	12M8
2%	200-800	7M8S		
2%	100-200	7M2		
2%	25-50	7L		
4%	50-200	7L2		

Typical Properties of Aqualon CMC*

Polymer Properties

Purity, dry basis, % min.....99.5
Moisture content (as packed), % max.....8.0
Browning temperature, °F (°C).....441 (227)
Charring temperature, °F (°C).....486 (252)
Bulk density, g/ml.....0.75
Biological oxygen demand, ppm
7H Types.....11,000
7L Types.....17,300

Solutions

pH, 2% solution.....7.5
Surface tension, 1% solution, dynes/cm.....71
Specific gravity, 2% solution.....1.0068

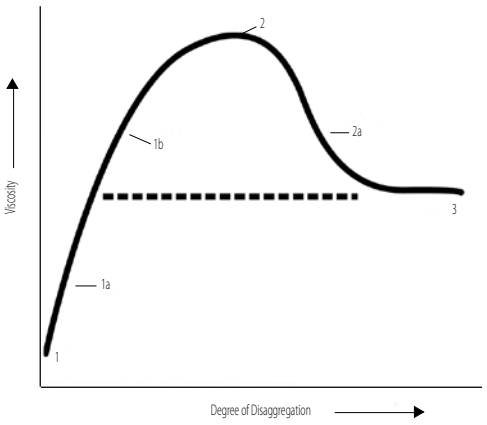
* Blanose CMC is produced in Alizay, France. Please review actual specifications for each product.

Dispersion and Dissolution

Figure 3 shows how states of disaggregation may affect viscosity of the liquid. If CMC is added to a liquid and its degree of disaggregation reaches equilibrium, the polymer may:

- Remain as a suspended powder, neither swelling nor dissolving (1).
- Swell to a point of maximum viscosity without completely dissolving (2).
- Reach maximum disaggregation (3).
- Exist in an intermediate state (1a, 1b, 2a).

Figure 3– Idealized Curve Showing Effect of Degree of Disaggregation on Viscosity of Polymer Solution



Thixotropic vs. Pseudoplastic Behavior

CMC solutions can exhibit a range of pseudoplastic (time-independent shear thinning) and thixotropic (time-dependent shear thinning) behavior. Generally, medium and high viscosity types with high DS (i.e., 9 and 12 types) and "S" types are more pseudoplastic. In contrast, high and medium viscosity grades of DS 7 types tend to exhibit more thixotropic behavior in solution.

Over time, more thixotropic types of CMC will exhibit a rather dramatic increase in apparent viscosity when the solution rests for a period time after shearing. In certain cases, it is desirable for the solution to develop gel strength such as in toothpastes and suspensions. When sufficient force is applied to these solutions, viscosity will drop at the interface and the gel will begin to flow, as in the extrusion of toothpaste from the tube.

Techniques for Preparing Solutions of CMC

Preferred method:

- Slurry dry CMC into a non-solvent until fully dispersed, then add slurry to vortex of solvating media (water)

Alternate methods:

- Slowly sift into vortex of well-agitated solvating media
- Dry blend with other ingredients, then slowly sift into the vortex of well agitated solvating media

Microbiological Information and Regulatory Status

Ashland Aqualon Functional Ingredients facilities for carboxymethylcellulose production are operated in compliance with Current Good Manufacturing Practice Regulations (CGMPR) as promulgated in the U.S. Code of Federal Regulations. While extreme care is exercised at every process step and the product is of excellent microbiological quality, CMC is not marketed as a sterile material; therefore, we recommend that our customers control the microbiological quality of their finished product through the application of appropriate process and formulation expertise.

Aqualon CMC is routinely sampled and subjected to microbiological testing by an independent laboratory and data are tabulated to provide an ongoing indicator of control in production. The data generated are not intended to be used to provide product specifications, but typical results obtained using our standard protocol, are shown below:

Aerobic Plate Count, cfu/g..... < 100
Mold, cfu/g..... < 100
Yeast, cfu/g..... < 100
Coliforms, MPN/g..... < 30
E. coli / 10 g.....negative
Staphylococcus aureus / 10 g.....negative
Salmonella / 25 g.....negative
Pseudomonas / 10 g .....negative

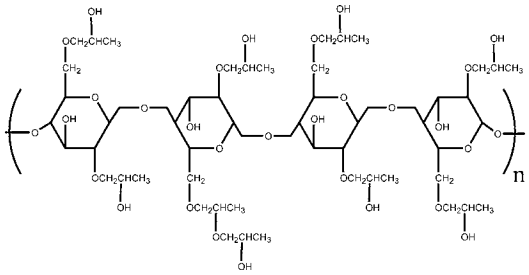
Ashland Aqualon Functional Ingredients utilizes official approved methods to determine the above microbial parameters, but recommends that users of Aqualon CMC assure themselves of compliance with any microbiological criterion by testing each lot.

Klucel® hydroxypropylcellulose

INCI Name: Hydroxypropylcellulose

Klucel hydroxypropylcellulose (HPC), a nonionic polymer, is a white to off-white, free flowing, granular solid with a remarkable combination of properties. It is made by reacting alkali cellulose with propylene oxide. The resultant polymer is purified, dried and ground. Manufactured in Ashland Aqualon Functional Ingredients GMP facility in Hopewell, Virginia, the high purity HPC (0.2% ash maximum) is offered in food (F), cosmetic (CS), and pharmaceutical (Pharm) grades.

Figure 1– Idealized Chemical Structure of Klucel HPC With an MS of 2.25



Klucel HPC is unique in that it is soluble in the broadest range of solvent systems of all the cellulose ethers. It is readily soluble in cold water, alcohols, many polar organic solvents, PEG and PG. HPC is generally insoluble in water over 105°F (40°C). However the precipitation phenomenon, occurs only in water and is fully reversible upon cooling.

Typical Applications in Personal Care

Klucel HPC is often used where advantage can be taken of its unique solubility in water, alcohol, or anhydrous systems. Klucel HPC is an excellent film-forming polymer which yields flexible, clear, thermoplastic, non-tacky films. This combination of properties makes it useful in the applications listed below:

- Hair styling gels
- Sprayed fixatives
- Denture adhesive film
- Shave gels and foams
- AP/Deodorants
- Suncare gels
- Hand sanitizer
- Mousses

Klucel HPC can be used to thicken aqueous and polar organic systems. Aqueous solutions of Klucel HPC are water-white and are of high clarity. High molecular weight grades, known as high viscosity types, are effective thickeners and film formers, while lower molecular weight grades are often employed for their excellent film forming properties.

Typical Properties of Klucel HPC

Physical Properties

Purity, dry basis, %, minimum calculated as Na_2SO_4 ash 99.5
Moisture content, as packed, % maximum 5.0
Softening temperature, °F (°C) 212-302 (100-150)
Bulk density, g/ml 0.5
Biological oxygen demand, ppm 14,000

Solutions

pH, 1% solution 5.5-8.0
Surface tension, 0.1% solution, dynes/cm 43.6
Specific gravity, 2% solution 1.010
Refractive index, 2% solution 1.337

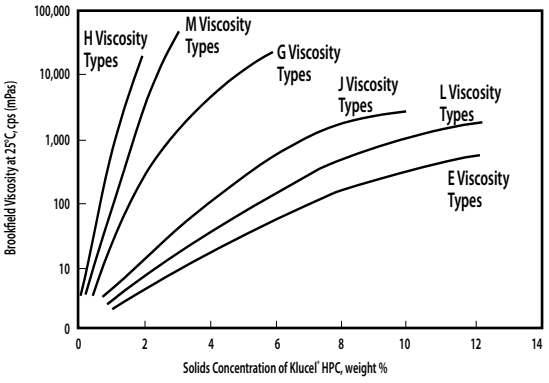
Solution Viscosity and Nomenclature

Klucel CS grade HPC is produced in six viscosity/MW types, designated as H, M, G, J, L and E. The grade designation is a combination of viscosity followed by regulatory type. For example: Klucel H CS HPC is a high viscosity cosmetic grade.

Solution viscosity in both water and ethanol for the various grades of Klucel CS HPC are found in the table below:

Klucel	% Solution	Water Viscosity Range, cps	Ethanol Viscosity Range, cps	Average Molecular Weight
H CS	1	1,500-3,000	1,000-4,000	1150K
M CS	2	4,000-6,500	3,000-6,500	850K
G CS	2	150-400	75-400	370K
J CS	5	150-400	75-400	140K
L CS	5	75-150	25-150	95K
E CS	10	200-600	150-700	80K

Figure 2- Effect of Concentration and Type of Klucel HPC on Viscosity of Water Solutions



Compatibility with Surfactants
Compatibility of Klucel CS HPC grades with surface-active agents will vary according to the particular agent and concentration, as well as to the grade and concentration of Klucel HPC used. Because of its hydroxypropyl substitution, Klucel HPC is more lipophilic in nature than other water-soluble cellulose derivatives. Accordingly, it is compatible with a wide range of anionic, nonionic, cationic, and amphoteric surfactants.

Techniques for Dispersion and Dissolution
HPC is soluble in water at room temp. The high MW types are insoluble in water above 104°F (41°C). The precipitation temperature varies depending on polymer MW and will slightly increase with decreasing MW types. HPC is readily soluble in many polar organic solvents, hot or cold. The techniques below describe methods for preparing solutions of Klucel HPC in various solvents.

In Water
The preferred method is to begin by heating approximately 1/3 of the total formulation water to approximately 75°C (167°F). Add the polymer to the heated water under agitation. Mix until fully dispersed. Klucel HPC will not dissolve at this temperature. After complete dispersion, add the remaining water at room temperature or colder and continue mixing until a smooth clear solution is obtained.

If the formulation contains other nonsolvents for HPC, such as glycerin, heating the pre-mix can be avoided by pre-slurrying the HPC powder in the nonsolvent (6:1 by weight) then add the slurry to the main volume of water.

In Alcohols
Begin with solvent at room temperature and under vigorous agitation. Sift the polymer into the vortex of the alcohol at a rate sufficiently slow so as to avoid lumping of the polymer. Continue mixing until a smooth clear solution is obtained.

Note: HPC displays borderline solubility in anhydrous isopropanol, however addition of 3-5% water will yield a clear and smooth solution.

In Propylene Glycol
Disperse the HPC polymer into the vortex of PG under good agitation. After dispersion, heat the solution to 122-140°F (50-60°C) and mix for 30 minutes. If necessary, homogenize for 15 minutes until free of granularity or lumps.

In Polyethylene Glycol (PEG-400 or Lower)
Only low MW types of HPC (Klucel E CS or L CS HPC) will yield clear smooth solutions. Disperse the HPC polymer into the vortex of PEG under good agitation. After dispersion, heat the solution to 176-194°F (80-90°C) and mix for 45 minutes. If necessary, homogenize for 15 minutes until free of granularity or lumps.

Other Organic Solvents
Klucel HPC is soluble in a wide variety of polar organic solvents. Reference Ashland Aqualon Functional Ingredients's booklet 250-2, *Klucel Hydroxypropylcellulose Physical and Chemical Properties*, for more information.

Microbiological Info and Regulatory Status
Ashland Aqualon Functional Ingredients facilities for hydroxypropylcellulose production are operated in compliance with Current Good Manufacturing Practice Regulations (CGMPR) as promulgated in the U.S. Code of Federal Regulations. While extreme care is exercised at every process step and the product is of excellent microbiological quality, HPC is not marketed as a sterile material; therefore, we recommend that our customers control the microbiological quality of their finished product through the application of appropriate process and formulation expertise.

Klucel HPC is routinely sampled and subjected to microbiological testing by an independent laboratory and data are tabulated to provide an ongoing indicator of control in production. The data generated are not intended to be used to provide product specifications, but typical results obtained using our standard protocol, are shown below:

Aerobic plate count, cfu/g	<100
Mold, cfu/g	<100
Yeast, cfu/g	<100
Coliforms, MPN/g	<30
E. coli / 10 g	Negative
Staphylococcus aureus / 10 g	Negative
Salmonella / 25 g	Negative
Pseudomonas / 10 g	Negative

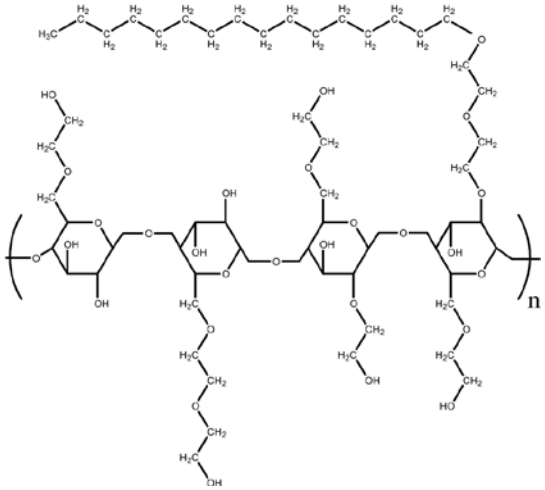
Ashland Aqualon Functional Ingredients utilizes official approved methods to determine the above microbial parameters, but recommends that users of Klucel HPC assure themselves of compliance with any microbiological criterion by testing each lot.

Natrosol® *Plus* and *PolySurf*® hydrophobically modified hydroxyethylcellulose (HMHEC)

INCI Name: Cetyl Hydroxyethylcellulose

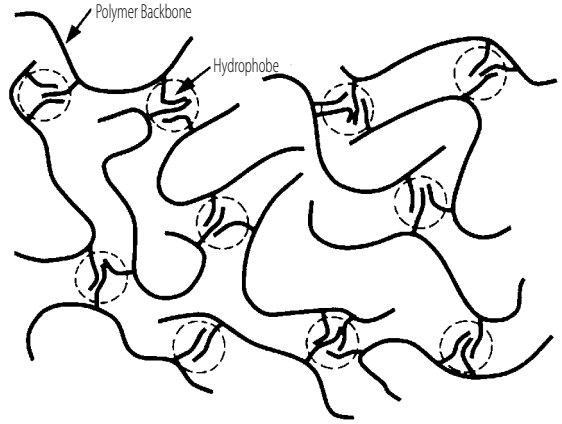
Hydrophobically modified hydroxyethylcellulose (HMHEC) is made in a two-step reaction. The first is the standard reaction of alkali-cellulose with ethylene oxide to produce HEC. The second step is a cetyl substitution, which provides the hydrophobic end groups. The resultant nonionic polymer is purified and dried. HMHEC for personal care and cosmetic applications is sold as Natrosol *Plus* 330 CS and *PolySurf* 67 CS.

Figure 1– Idealized Chemical Structure of Natrosol *Plus* 330 CS and *PolySurf* 67 CS



HMHEC polymers are unique in that they function as associative thickeners, meaning they not only thicken aqueous systems via chain entanglement and conventional hydrogen bonding, but also via hydrophobe interactions. In solution, hydrophobe groups seek out other hydrophobes, including oils and pigments, forming weak interactions, and effectively creating a three-dimensional polymer network.

Figure 2–Illustration of Associative Thickening via Hydrophobe Interaction



The hydrophobic modification imparts many unique properties to HMHEC polymers including pseudoplastic shear thinning behavior, high salt tolerance and long term stability over a very wide pH range (3.5-11). (See Figure 3.) Furthermore, HMHEC also behaves as a polymeric co-emulsifier and can be used to stabilize O/W emulsions without the use of conventional high HLB, water-soluble surfactants, thus removing the major component leading to skin irritation and enabling a much milder formulation.

Typical Applications in Personal Care

HMHEC is found in a variety of applications in personal care and cosmetics. Some of the more common applications are as follows:

- Liquid soap and body wash
- Wipes (baby and adult)
- Shampoo and conditioner
- Hair styling products
- Liquid makeup and mascara
- AP/Deodorant

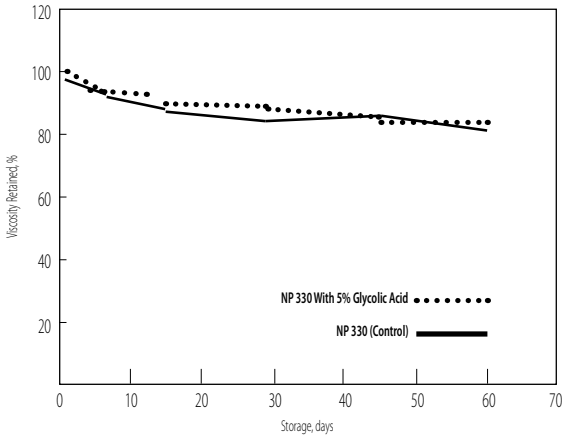
In addition to associative thickening of aqueous systems, HMHEC is chosen for its shear-thinning behavior and broad pH stability, providing an elegant and non-tacky feel to both skin and hair care products. The suspending properties are also chosen to provide yield and stability in heavy pigment suspensions.

Typical Properties of Natrosol *Plus* 330 CS and *PolySurf* CS

	Natrosol *Plus* 330 CS	*PolySurf* 67
Brookfield viscosity, 1% solution, cps	150-500	8,000-13,000
Average molecular weight	350,000	550,000
Moisture content, % maximum	5	5
Ash content, % maximum, calculated as Na_2SO_4	5	5

pH Stability

Figure 3– Viscosity Stability of 2% Natrosol *Plus* 330CS Solution With 5% Glycolic Acid at 104°F (40°C), pH = 1.9



Techniques for Preparing Solutions of HMHEC

Ashland Aqualon Functional Ingredients HMHEC polymers for personal care are R treated for easier dissolution without lumping in aqueous solutions. Reference the Natrosol HEC section of this publication for specific details on dissolution and dispersion of R treated polymers into solution.

Benecel® methylcellulose (MC) and hydroxypropyl methylcellulose (HPMC)

INCI Names: Methylcellulose (MC)
Hydroxypropyl Methylcellulose (HPMC)

Benecel methylcellulose (MC) is made by reacting methyl chloride with alkali-cellulose under rigidly controlled conditions. The resultant nonionic polymer is purified, dried and ground to a fine white powder, which is readily soluble in cold water. It is also possible to graft a hydroxypropyl group onto the MC polymer backbone, creating Benecel hydroxypropyl methylcellulose (HPMC). Also a nonionic, cold water-soluble polymer, HPMC is a good film-former and varies somewhat in physical and chemical properties from MC. Benecel MC and HPMC are quite hydrophilic and readily soluble in cold water. As the water temperature is raised, they pass through a thermal gellation phase, where solution viscosity rises rapidly, followed by flocculation and precipitation of the polymer out of solution. This precipitation is thermally reversible and occurs at different temperatures, depending on type and degree of substitution (DS). Benecel MC and HPMC are compatible with most personal care surfactant systems.

Figure 1– Idealized Chemical Structure of Methylcellulose

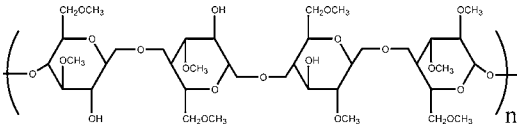
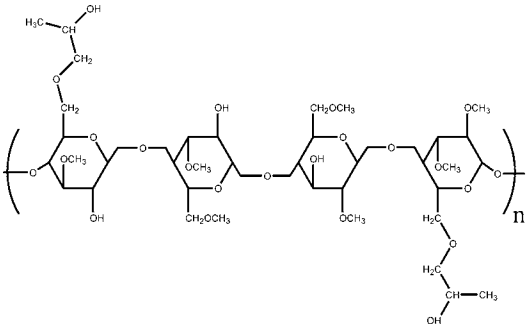


Figure 2– Idealized Chemical Structure of Hydroxypropyl Methylcellulose



Typical Applications in Personal Care

MC and HPMC are used in a variety of applications in personal care and cosmetics. Examples are as follows:

- Shampoo
- Liquid bubble bath concentrate
- Liquid soap and body wash
- Hair styling products
- Lotions and creams

In particular, HPMC is chosen for its foam enhancing properties in surfactant systems. When used in a shampoo or body wash, the HPMC polymer helps with formation of bubble structure, leading to richer, longer lasting lather.

Physical Properties

Purity, dry basis, %, minimum 98.0
Softening temperature, °F (°C) 284 (140)
Decomposition temperature, °F (°C) ..... >428 (>220)
Bulk density, g/ml 0.25-0.5
Biological oxygen demand, mgO_2/mg product 0-0.1

Solution Properties

Flocculation temperature, °F (°C)

A Types 122-167 (50-75)
E, F, K Types 140-194 (60-90)
pH, 2% solution 5.5-8.0
Surface tension, 0.1% solution, dynes/cm 45-55
Specific gravity, 2% solution 1.0032

Techniques for Preparing Solutions of MC and HPMC

It is important to note that MC and HPMC are somewhat unique in that solubility increases in colder water. They also exhibit a tendency to lump upon introduction to cold water. Once lumping has occurred, it becomes difficult to obtain complete dissolution. For these reasons, it is critical to adhere to the following guidelines for dispersion and dissolution. The preferred method is to begin by heating approximately 1/3 of the total formulation water to 167°F (75°C) or higher. Add the polymer to the vortex of agitated and heated water. Mix until fully dispersed. Benecel MC and HPMC will not dissolve at this temperature. After complete dispersion, add the remaining water at room temperature or colder and continue mixing for 30 minutes after the total solution has cooled to 77°F (25°C) or less. If heating is impossible, it is preferred to slurry the polymer in non-solvating media, such as glycerol or PEG, then add the slurry to the vortex of vigorously agitated water. Adding polymer directly to cold water is not preferred, but if necessary, must be done very slowly under vigorous agitation. Expect longer mixing times for complete dissolution.

Benecel Methylcellulose and Hydroxypropyl Methylcellulose Product Line for Personal Care

Grade	Chemistry	2% Water mPas	Methoxyl Content, %	Hydroxypropyl Content, %
A4C	MC	320-480[1]	27.5-31.5	–
A4M	MC	2,700-5,040[1]	27.5-31.5	–
E10M	HPMC	7,500-14,000[2]	28.0-30.0	7.0-12.0
F4M C	HPMC	2,700-5,040[2]	19.0-30.0	3.0-12.0
K99 C	HPMC	80-120[1]	20.0-24.0	7.0-12.0
K4M	HPMC	2,700-5,040[2]	20.0-24.0	7.0-12.0
K15M	HPMC	13,500-25,200[2]	20.0-24.0	7.0-12.0
K35M	HPMC	26,250-49,000[2]	20.0-24.0	7.0-12.0
K100M	HPMC	75,000-140,000[2]	20.0-24.0	7.0-12.0
K200M	HPMC	150,000-280,000[2]	20.0-24.0	7.0-12.0

[1]EP Ubbelohde Viscosity, [2]EP Brookfield Viscosity

AquaCat® clear cationic solution

INCI Name: Guar Hydroxypropyltrimonium Chloride

AquaCat clear cationic solutions are aqueous solutions of cationic guar, developed specifically for use as substantive polymeric conditioners for hair and skin care applications. They have been shown to be compatible, and to maintain unsurpassed finished product clarity with a wide variety of both anionic and amphoteric surfactant blends. Finished product clarity may be achieved even at relatively high use levels. AquaCat solutions are supplied as ready-to-use, 10% nominal solids, clear liquid, odor-free solutions, requiring no heat or pH adjustment.

Typical Solution Properties (as supplied)

Appearance	clear, pale amber liquid
Total solids, weight %	10.0 nominal
pH	5.0 – 7.0
Density, g/cc	1.04 – 1.06
Viscosity, as received, cps	< 400

AquaCat CG518 solution

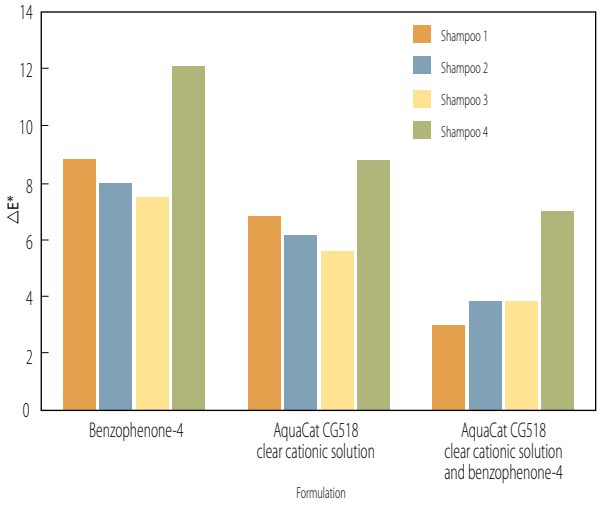
AquaCat CG518 clear cationic solution, the flagship product in this line, is highly effective for any clear, conditioning shampoo formulations. AquaCat CG518 solutions are preserved with two highly effective personal care preservatives which are a blend of parabens and phenoxyethanol. The addition levels we use are well within the suppliers' use recommendations. We have tested several representative production lots of AquaCat CG518 solutions and have analytically established that the levels present do not exceed 0.2% for the paraben blend and 1% for phenoxyethanol.

AquaCat CG518 clear cationic solution stands out from other polyquats because of its demonstrated lack of buildup on hair following frequent shampooing and its unparalleled ability to enable crystal-clear formulations in virtually all commonly-employed surfactant blends for adult, baby and pet hair care. AquaCat CG518 solution's targeted conditioning adsorbs where it's needed most, smoothing rough cuticle edges and resulting in excellent detangling, enhanced wet and dry comb performance, and soft touch aesthetics...all without polymer buildup. Studies have shown AquaCat CG518 solutions to also add superior gloss to hair and aid in color retention on treated hair when paired with benzophenone-4 (See Figure 1). AquaCat CG518 solution's low viscosity liquid form makes it simple to handle.

AquaCat PF618 solution

In response to the market demand for a conditioner without parabens, AquaCat CG518 solution's paraben-free analog, AquaCat PF618 clear cationic solution, was created. This solution performs exactly like its predecessor except that it contains no parabens. Instead, the commercial version of AquaCat PF618 clear cationic solution is preserved with a blend of benzoic acid and dihydroxyacetone in phenoxyethanol.

Figure 1 – △E From Original Hair Color as a Result of Wash Out



*△E = Total color difference. △E is calculated from a combination of lightness, red-green, and blue-yellow characteristics of the test subject.

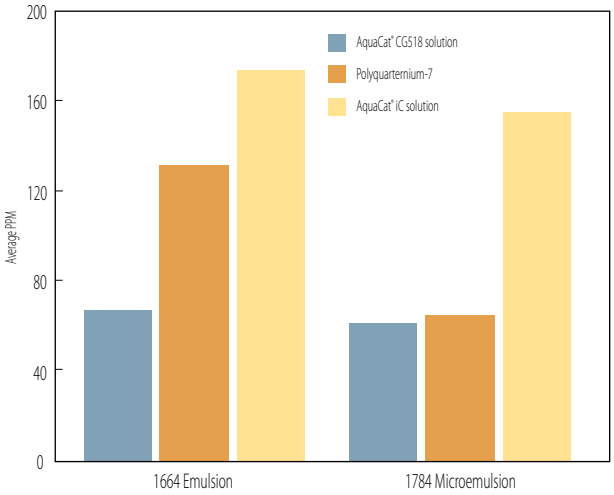
- Crystal clear finished products
- Superior gloss
- Excellent wet and dry hair feel
- No build up on hair
- Clean smooth skin feel
- Improved color retention on treated hair
- Reduced batch cycle times
- No dissolving step
- No pH adjustment required
- No heating required

AquaCat iC solution

INCI Name: Guar Hydroxypropyltrimonium Chloride (and) Polyquaternium-7

AquaCat iC clear cationic solution functions exactly the same as the AquaCat PF618, and additionally delivers silicone deposition (See Figure 2). The addition of Polyquaternium-7 (PQ-7) has a synergistic effect which minimizes static charge and therefore significantly reduces flyaway. AquaCat iC solution has been shown to provide tremendous detangling benefits during wet combing, as well as dry comb improvement. Like the commercial version of AquaCat PF618 solution, the commercial version of AquaCat iC solution is paraben-free. It is preserved with a blend of benzoic acid and dihydroxyacetone in phenoxyethanol.

Figure 2– Silicone Deposition–1664 Emulsion vs. 1784 Microemulsion Blended With AquaCat® CG518 Solution, Polyquarternium 7, and AquaCat® iC Solution



Typical Applications in Personal Care

AquaCat clear cationic solutions are recommended for use in a variety of hair and skin care applications. Their utilities are best realized in clear, conditioning or 2-in-1 shampoos, body washes and liquid soap formulations. In 2-in-1 conditioning shampoo formulations, AquaCat solutions has been shown to provide excellent detangling benefits during wet combing, as well as enhancement of dry combing. In addition, AquaCat solution does not build-up on the hair in day-to-day usage. In skin care products, cationic guar provides a lubricious feeling, which is often perceived by the consumer as a softer, smoother and moisturized skin feel.

Recommended use levels are 0.2%-0.5% (dry polymer basis) (2%-5% wet basis) in hair care applications. In skin care applications, such as body washes or liquid hand soaps, higher levels of AquaCat solution (up to 1.0% dry basis) may be appropriate and can be incorporated with retention of finished product clarity.

PrimaFlo® HP22 polymer solution

INCI Name: Hydroxypropylcellulose

PrimaFlo HP22 polymer solution is an aqueous solution of hydroxypropylcellulose (HPC) developed specifically for use as a film-former in personal care formulations. It is fully compatible with hydro-alcoholic systems.

NOTE: For chemical structure information, reference the Klucel hydroxypropylcellulose section of this publication.

Typical Solution Properties (as supplied)

Appearance	clear, pale yellow liquid
Total Solids, weight %	21-23
pH, nominal	6.0
Density, nominal, g/cc	1.05
Viscosity, Brookfield LVF, nominal, as received, cps	15,000

HPC Polymer Properties

MW, nominal	80,000

Typical Applications in Personal Care

PrimaFlo HP22 polymer solution is recommended for use in hair and skin care formulations requiring flexible film-forming and solution clarity. Typical applications include soft-hold hair fixative products such as gels, spritzes and mousses. PrimaFlo HP22 polymer solution can be used alone, for soft hold and anti-frizz benefits or in combination with firm hold fixatives, where it acts as a plasticizer. In skin care, such as bath splashes, spritzes, and aftershave, the film properties of HPC supplement fragrance longevity.

Typical use levels are 2-5% (wet basis).

Techniques for Addition of PrimaFlo HP22

PrimaFlo HP22 polymer solution may be added at any stage during processing. This includes addition up front to formulation water, followed by other ingredients, or addition at the very end of the batch.

1. Add PrimaFlo HP22 polymer solution by pumping or gravity feed to vessel under continuous mixing.
2. Allow to mix 5 minutes for complete hydration[1], before addition of other ingredients or filling.

[1] Note: As HPC has a cloud point (The temperature above which it becomes insoluble in water), the batch temperature must be below 105°F (40°C) for hydration to occur.

For addition information, request Ashland Aqualon Functional Ingredients *Product Data Sheet Number 4213* or visit ashland.aqualon.com.

Supercol® guar gum

INCI Name: Cyamopsis Tetragonoloba (Guar Gum)

Supercol guar gum is a high purity, water soluble polymer that functions in personal care by changing the viscosity of the water or controlling its mobility. In this way, usable stabilization, thickening, water-binding, and viscosity control are produced throughout the personal care industry.

Characteristics

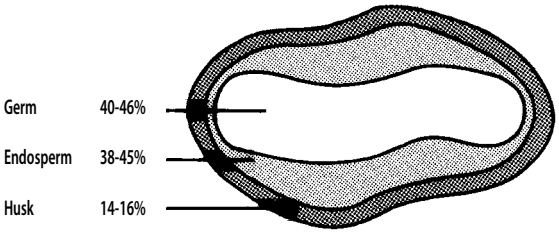
- All-natural thickener
- Nonthixotropic
- Lather stabilizer
- Syneresis control

Applications

- Shampoo and conditioner
- Shave preparations
- Air fresheners
- Lotions and creams

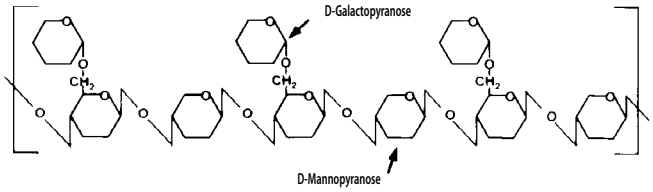
Guar is a leguminous plant that grows to a height of three to six feet. It bears many beanlike pods, each of which contains six to nine small, rounded seeds. Supercol guar gum is prepared by removing the husk and germ portions before extracting the gum from the endosperm, to yield high-purity powder products of varying granulation and viscosity.

Figure 1–Guar Seed Kernel



Chemically, guar is a galactomannan, best illustrated with galactose on every other mannose unit.

Figure 2–Idealized Chemical Structure of Guar Gum

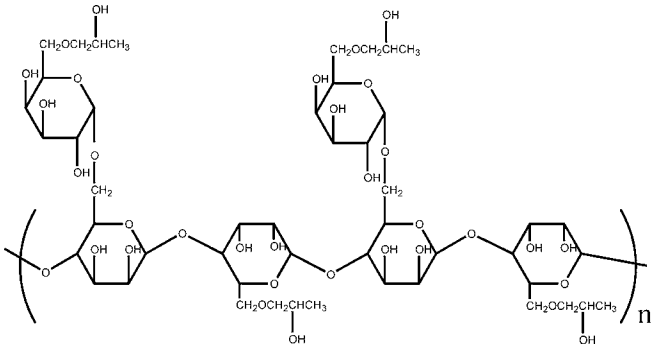


N-Hance® HP Series hydroxypropyl guar

INCI Name: Hydroxypropyl Guar

N-Hance hydroxypropyl (HP) guar is a nonionic polymeric thickener and film former. It is often specified in personal care formulations to take advantage of its characteristic high level of lubricity as well as excellent salt and alcohol tolerance in aqueous solutions. Ashland Aqualon Functional Ingredients offers HP guar in a buffered self-hydrating grade (HP-40S) as well as a non-buffered grade (HP-40). Solutions of HP guar will be slightly hazy.

Figure 1–Idealized Chemical Structure of Hydroxypropyl Guar



Typical Applications in Personal Care

N-Hance HP guar is used in numerous application for skin and hair care products. In particular, it is used for lubrication and film properties. Some of the more common applications are as follows:

- Anti-frizz hair styling products
- Wipes (baby and adult)
- Shave gels (especially women's)
- Shampoos and body wash (pearlescent)
- Hand and body lotions

Techniques For Preparing Solutions of HP Guar

Follow the instructions listed for N-Hance 3000 Series cationic guar. The HP-40S is analagous to N-Hance CG-13 self-hydrating cationic guar.

For physical properties and microbiological information, please request product-specific data sheets or visit ashland.aqualon.com.

Typical Properties of Supercol Guar Gum

Grade[1]	Granulation Form	Granulation Mesh	Viscosity[2] As-Is Basis	Rate	Peak Viscosity Developed in 15 min (Cold), %	Dispersibility in Water at 25°C
G3-S	Coarse	60	4,000	Slow	40	Excellent
G2-S	Medium-coarse	80	4,500	Moderate	50	Excellent
GF	Medium-fine	150	4,500	Fast	70	Very good (requires some care)
U	Fine	200	5,100	Very fast	90	Fair (requires care)
US	Fine	200	5,500	Very fast	90	Fair (requires care)
K-1	Medium-fine	150	1,200	Slow	30	Fair (requires care)
221	Medium-fine	150	3,000	Moderate	65	Very good

[1] These grades of guar gum are popular in the food industry. Custom grades or blends can be made by request.

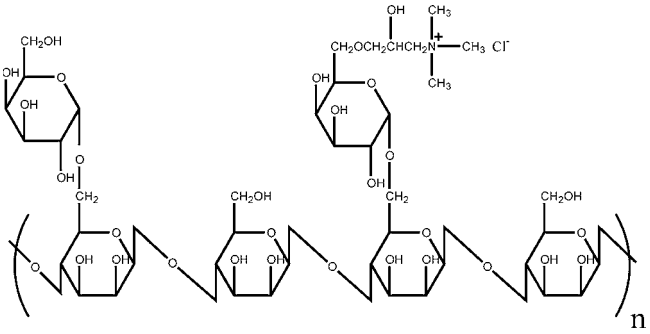
[2] Dispersed in cold water to form a 1% solution. Viscosity was measured at 25°C after 2 hours, using a Brookfield RVT viscometer at 20 rpm and reported on an as-is basis.

N-Hance® cationic guar

INCI Name: Guar Hydroxypropyltrimonium Chloride

N-Hance cationic guar is a cationic polymer that provides the dual benefits of conditioning and thickening. The cationic charge makes the product substantive to anionic surfaces such as skin and hair. The high molecular weight, water-soluble backbone creates viscosity in aqueous solutions.

Figure 1–Idealized Chemical Structure of Cationic Guar



Typical Applications in Personal Care

N-Hance cationic guar is found in a variety of applications in hair and skin care. Though cationic, it is compatible with most anionic and amphoteric surfactants used in shampoos, body wash and liquid hand soaps. Some of the more common applications are as follows:

- Shampoo and conditioner
- Hair styling products
- Shaving gels and foams
- Liquid soap and body wash
- Wipes (baby and adult)
- Bar soaps
- Moisturizing lotions and creams

As a conditioning agent to hair, cationic guar offers excellent detangling properties and enhances the feel of dry hair. As such, it is often specified as a conditioning polymer in 2-in-1 shampoos at typical use levels of 0.2-0.5%. In body wash, liquid hand soap and shave preps, cationic guar lubricates and leaves a soft, luxurious afterfeel, typically perceived by consumers as a moisturizing effect. Typical use levels in body wash are 0.4-0.75%.

Techniques for Preparing Solutions of Cationic Guar

N-Hance CG and 3000 series cationic guars are lightly surface treated with borax to ensure good dispersibility in water. Add N-Hance cationic guar to the vortex of wellagitated water and mix until well dispersed. Adjust to a pH of ~5.5 (with acetic, citric, fumaric or other organic acid) to remove the surface treatment and promote rapid hydration of the polymer. Continue mixing for 60 minutes for full viscosity development. N-Hance BF-13 and BF-17 cationic guars are boron-free and are cross-linked with glyoxal. These polymers should be dispersed in cold water at a pH of between 3 and 4. This lump-free dispersion can then be added to the remaining formulation components. The dispersion will remain fluid and easily pumpable for ~ 30 minutes, as long as the pH remains less than 4. After 30 minutes, the pH will rise to about 4.5 and the material will begin to dissolve. Faster and complete dissolution of polymer can be achieved by postadding dilute caustic to the dispersion to raise the pH to 7 or higher. After 30 minutes of mixing, the polymer will be fully dissolved.

N-Hance CG-13 cationic guar is buffered for rapid hydration. As such, hydration begins almost immediately when added to the vortex of well-agitated water. Continue mixing for 30 minutes or longer for full viscosity development.

For physical properties and microbiological information, please request product-specific data sheets or visit ashland.aqualon.com.

N-Hance 3000 and CG Series Cationic Guar Product Line for Personal Care

Grade	% Nitrogen	Charge Density	1% Water*	pH, as is	Self-Hydrating
BF 17 (Boron Free)	Very High	Very High	2,500[2b]	5.5	No
3215	High	High	4,200[1b]	10.0	No
CCG450	High	High	700[2b]	10.0	No
3196	Medium	Medium	4,500[1b]	10.0	No
BF 13 (Boron Free)	Medium	Medium	2,500[2b]	5.5	No
CG 13	Medium	Medium	3,500[2b]	7.0	Yes
CCG 45	Medium	Medium	40[2b]	10.0	No
3000	Low	Low	2,700[1a]	10.0	No
HPCG 1000	Medium	Medium	800[2b]	10.0	No.

[1] Solution concentrations based on "moisture-free" polymer.

[2] Solution concentrations based on "as-is" polymer.

[a] Brookfield LV @ 6rpm.

[b] Brookfield RV @ 20rpm

Polymers for personal care

					Solubility		
	Acronym	INCI Name	Ionic Nature	Room Temperature Water	Water >122°F (50°C)	Ethyl Alcohol	Polar Organic Solvents
Natrosol® hydroxyethylcellulose	HEC	Hydroxyethylcellulose	Nonionic	S	S	I	I
Aqualon® sodium carboxymethylcellulose	CMC	Cellulose gum	Anionic	S	S	I	I
Klucel® hydroxypropylcellulose	HPC	Hydroxypropylcellulose	Nonionic	S	I	S	S
Natrosol® *Plus* and ***PolySurf®*** cetyl hydroxyethylcellulose	HMHEC	Cetyl Hydroxyethylcellulose	Nonionic	S	S	PS	I
Benecel® methylcellulose and hydroxypropyl methylcellulose	MC and HPMC	Methylcellulose and Hydroxypropyl Methylcellulose	Nonionic	S	I	I	I
PrimaFlo HP22 hydroxypropylcellulose solution	HPC Solution	Hydroxypropylcellulose	Nonionic	S	I	S	S
N-Hance® HP Series hydroxypropyl guar	HP Guar	Hydroxypropyl Guar	Nonionic	S	S	I	I
N-Hance® 3000 Series, N-Hance® CG Series, N-Hance BF series and **N-Hance HPCG series** cationic guar	Cat Guar	Guar Hydroxypropyltrimonium Chloride	Cationic	S	S	I	I
AquaCat® clear cationic solution	Cat Guar	Guar Hydroxypropyltrimonium Chloride	Cationic	S	S	I	I
Supercol® guar gum		Cyamopsis Tetragonoloba Guar Gum	Nonionic	S	S	I	I
N-Hance® SP Series synthetic conditiong polymers		Acrylamido Propyltrimonium Chloride/ Acrylamide Copolymer	Cationic	S	S		

*Natrosol *Plus* 330 CS is partially soluble in propylene glycol and generally insoluble in polyethylene glycol.

		Compatibility		Polymer Film Properties					
				Tensile Properties				24-Hour Water Vapor Transmission	
PG/ PEG	Glycerol	5% NaCl	15% NaCl	Strength, psi	Elongation, % Stick	Modulus, psi	Oxygen Transmission cc/m²/atm	g/m² at 73°F (23°C) and 50% RH	g/m² at 100°F (38°C) and 50% RH
I	S	C	C	6,500	25	185,000	25	300	9,000
I	I	C	C	15,000	7	1,000,000	10	300	9,000
S	I	C	NC	5,000	45	95,000	700	150	3,500
PS*	ND	C	C	3,000	45	30,000	25	175	7,500
I	I	C	NC	12,000	15	500,000	1,600	400	4,500
S	S	C	NC	ND	ND	ND	ND	ND	ND
I	I	ND	ND	ND	ND	ND	ND	ND	ND
I	I	NC	NC	ND	ND	ND	ND	ND	ND
I	I	ND	ND	ND	ND	ND	ND	ND	ND
I	I	ND	ND	ND	ND	ND	ND	ND	ND

S = Soluble I = Insoluble C = Compatible NC = Not Compatible PS = Partially Soluble ND = Not Determined

Quick guide

for Dispersion and Dissolution of Aqualon Water-Soluble Polymers

	Dispersion and Dissolution Technique			
	Preferred Method	Alternate Method(s)		Method
Natrosol® hydroxyethylcellulose (R Type)	4	7		**1** Slowly sift into vortex of well agitated solvating media (water)
Aqualon® sodium carboxymethylcellulose	2	3, 1	Disperse	**2** Slurry in non-solvent, then add to water while mixing the slurry
Klucel® hydroxypropylcellulose (HPC)	6	2, 1		**3** Dry blend with other ingredients, then slowly sift into the vortex of well agitated solvating media (water)
Natrosol® hydroxyethylcellulose (Pharm)	2	3, 1		**4** Add polymer at pH below 6.5, then raise solution pH to >8.5
Benecel® hydroxypropyl methylcellulose	6	2, 1	Hydrate	**5** Add polymer at pH above 7.0, then lower solution pH to <6.5
N-Hance® HP Series hydroxypropyl guar*	5			**6** Add to hot water 160-170°F (70-80°C), allow to cool while mixing
N-Hance® 3000 Series, N-Hance® CG Series and **N-Hance HPCG Series** cationic guar*	5			**7** Disperse polymer in RT water, then heat to 176-194°F (80°-90°C) until dissolved
Supercol® guar gum	2	3,1		
N-Hance® BF Series cationic guar	4	7	Dissolve	
N-Hance® SP Series cationic guar	3	1		

* Use Method 1 for self-hydrating versions, N-Hance CG-13 cationic guar, and N-Hance HP-40S hydroxypropyl guar.

Ashland Aqualon Functional Ingredients takes thoughtful and deliberate steps to have a beneficial impact on the environment. Our efforts span the resources we choose, the energy we use, and the influential role our products play in improving the environmental performance of our customers. Most of Ashland Aqualon Functional Ingredients' products are derived from natural and renewable raw materials. Alternative and natural resources provide environmental advantages over petroleum-based materials and reduce their use in the manufacturing process. The result is often cleaner, greener products and processes that improve efficiencies and performance, while reducing dependence on hydrocarbons. Our emphasis on green chemistry encompasses reformulations and process improvements to reduce or eliminate hazardous substances, by-products, and contaminants.

Naturally, a better solution[SM]

Polymers for hair care

- **Shampoos**
- **Conditioners**
- **Styling gels**
- **Styling mousse**

Polymers for oral care

- **Toothpaste**
- **Denture adhesive**
- **Mouthwash**

Polymers for skin care

- **Bubble bath**
- **Body wash**
- **Liquid hand soap**
- **Shave gels**
- **AP/DEO**
- **Color cosmetics**
- **Creams, lotions and ointments**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