Green-Polymers for Natural-Spa formulations

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Personal care applications
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The Greening of Spas

- Spa trends are going green
- Using Green, Natural, Organic products
- Sustainable and environmental friendly spa design
- Planting organic gardens (Spa Kitchen)
Polysaccharides the Green-polymers

Polysaccharides are sugar based polymers. They are polymers made up of many monosaccharide joined together.

- Micro-fibrous cellulose
- Pectin
- Xanthan gum
- Gellan gum
- Carrageenan
- Carboxymethyl cellulose
Green-polymers in Spa trend

- Carbohydrate based polymers
  - Biodegradable

- Sourced & made from sustainable nature-based ingredients
  - Citrus Peel
  - Seaweed
  - Corn-based Sweeteners

- Many of the products have
  - Broad pH stability
  - Good electrolyte compatibility

- Xanthan gum, Carrageenan, Pectin*
  listed as allowable ingredients
  USDA NOP, Whole foods, NPA, JECFA, EEC

*(excluding amidated Pectin)-amidated pectin is only allowed by USDA NOP.
Value Chain

Natural Raw Materials
- Citrus Fruit
- Seaweed
- Corn
- Wood
- Cotton

Extraction Process
- Acid Extraction
- Alkaline Extraction
- Biofermentation
- Substitution

Green Polymers
- Pectin
- Carrageenan
- Xanthan gum
- Gellan gum
- Cellulose gum
- Micro-fibrous cellulose

Unique Functionalities
- Gel
- Thicken
- Stabilize
- Control flow
- Suspend
- Film forming

Key Product Attributes
- Targeted texture
- Firm, soft
- Fluid gel
- Smooth, dry
- Non Tacky
- Rich, creamy

Consumer Differentiation
- Natural
- Unique texture
- Unique sensory profile
- Potential claims
- Labeling
- Actives’delivery
Micro-fibrous cellulose Blend

- Suspension in surfactant thickened system.
- Option for acrylate replacement
- Biodegradable, Cost saving, route for suspension in surfactant system

Applications

- Foaming Body scrub
- Exfoliating facial cleanser
- Invigorating Lemongrass body wash with multi vitamin beads
- Moisturizing shampoo with moisture actives
- Shimmer moisturizing shampoo
- Anti dandruff shampoo
- Mild SLS/SLES/ acrylate free shower gel
- Foaming hand soap with glitters
Micro-fibrous cellulose Blend

- INCI-cellulose, xanthan gum, cellulose gum
- Fermentation-derived cellulose—biodegradable
- Chemically identical to plant-derived cellulose
- Ultra-fine insoluble cellulose fibers are 0.1-0.2 µm diameter and of indeterminate length
- Patented technology
Comparison of Cellulosic Stabilizers

<table>
<thead>
<tr>
<th>Soluble</th>
<th>Insoluble</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMC</td>
<td>MFC</td>
</tr>
</tbody>
</table>

- CMC: Insoluble
- MFC: Soluble
- MCC: Soluble
- Wood Pulp Fiber: 0.1 - 0.2 micron diameter
Micro-fibrous cellulose blend

Rheology & Key attributes:
- Forms invisible and insoluble three-dimensional network in water
- Suspension without adding to the perceived viscosity
- Shows high compatibility with surfactants & micelle formation
- Formulation diversity- effective in broad range of surfactant rheology
- Enables clear formulations
- Excellent temperature, pH and salt stability
- Low use level- 0.05% to 0.2%
- Compatible with latest high surfactant formulations (2x, 3x)
- Needs high shear activation to be functional
  - eg. Silverson homogenizer
- Can be made as concentrate (e.g. 1% or less), then diluted at low shear
- Cold Process
**Lemongrass Body Wash with Microfibrous cellulose blend (No SLS / SLES/Acrylate )**

<table>
<thead>
<tr>
<th>INCI Nomenclature</th>
<th>% w/w (Qty)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (Aqua)</td>
<td>q.s. to 100</td>
</tr>
<tr>
<td>Cellulose, Xanthan Gum, Cellulose Gum</td>
<td>0.08</td>
</tr>
<tr>
<td>Sodium C14-16 Olefin Sulfonate</td>
<td>25</td>
</tr>
<tr>
<td>Cocamidopropyl Hydroxysultaine</td>
<td>6</td>
</tr>
<tr>
<td>PEG-150 Distearate</td>
<td>1.5</td>
</tr>
<tr>
<td>Cymbopogon schoenanthus extract</td>
<td>0.5</td>
</tr>
<tr>
<td>Fragrance</td>
<td>q.s.</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>1.75</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>q.s.</td>
</tr>
<tr>
<td>Preservative/color/beads</td>
<td>q.s.</td>
</tr>
</tbody>
</table>

**Preparing 1% MFC blend Concentrate: 1litre**
Disperse 10gm of AxCel in 990gm distilled water under high-speed propeller mixing. Mix it for 5 min to break the lumps if any. Homogenize MFC blend dispersion for 10min @ 10000 rpm using Silverson’s L4RT-A homogenizer. This is your 1% MFC blend concentrate. (If you are using any other homogenizer or making a bigger batch, please refer to our document on AxCel activation. Please use our microscopic- technique to verify that you have Activated AxCel CG-PX completely. Activation of MFC blend is very critical for achieving good-results)

**Preparation of Body wash-** Disperse 1% MFC blend concentrate into available water under propeller mixing. Add other ingredients slowly with mixing one by one and heat till 70-75°C to melt PEG 6000. Once PEG 6000 is completely melted start cooling with propeller mixing . Below 40-45 ° C, add extracts and frgrance and preservatives one by one with mixing. Adjust viscosity with salt and pH with citric acid solution. When the product reaches RT and is thick, slowly add beads with mixing. Adjust for water loss .De-aerate.

Please contact us for detail information on formulation
Micro-fibrous cellulose blend

FOAMING HAND SOAP  
DISH SOAP  
BODY WASH

Water-thin  
Honey-like thickness
Pectin Blend

- Proven ingredient for moisturization & protection. A mild ingredient for skin’s wellbeing.

Applications:
- Normalizing soothing cream (after treatment)
- Post depilatory emulsion
- Hydrating lotion for sensitive skin
- Relaxing serum
- Calming Body lotion
- Protective Hand cream
- Normalizing lotion for acne prone skin
Pectin Blend

- INCI: Pectin
- Extracted from Citrus peel
- Partially methoxylated poly D-galacturonic acid

- Types:  
  - LM Pectin DE< 50
  - HM Pectin DE > 50
  - Blend Of LM & HM

- Key attributes:
  - Restores skin’s natural pH
  - Moisturizes skin
  - Improves skin barrier function
  - GRAS ingredient
  - Stable at low pH (below 5)
  - Can Impart emollient skin feel
  - Non-irritating and non-sensitizing
Effect of damaged Skin Barrier

- Skin irritation, Dry skin, Itching, Infections, Growth of harmful bacteria
- **Low pH is Important**
- Formation and the repair of Lipid barrier- (Prevents dehydration & irritation)
- Inhibiting proliferation of acne bacteria-*Propionibacterium acnes*
- In the local treatment of dandruff, seborrheic dermatitis of scalp
- Smooth the cuticle- Prevent moisture loss

**Pectin Blend** - pH normalizing, Moisturization, Protection
Pectin Blend

Weak acid – pKa about 4

Low DE (more acid) High buffering

\[
\text{R-COOH} + \text{OH}^- \rightleftharpoons \text{R-COO}^- + \text{H}_2\text{O}
\]

High DE (more ester) sustained buffering

\[
\text{R-COOCH}_3 + \text{OH}^- \rightarrow \text{R-COO}^- + \text{CH}_3\text{OH}
\]

Blend

Combination of high and low DE provides both features
In Vivo Clinical Tests

BioScreen Testing Services, Inc – California, USA, Jan 2006
- 29 persons in the age range 18 – 65
- Control on forearms, both sites washed with soap
- Skin capacitance evaluated with Corneometer CM825, TEWL and pH controls
- Measurements on untreated control as baseline, following soap wash and 1 hour after soap wash when skin reequilibrium is obtained.

Conclusion:
Significant difference (p<0.0177) between post treatment and post control showed a moisturizing effect of stratum corneum
Directional increase in barrier function protection
Highly significant pH buffering capacity
In Vivo Clinical Tests

- Institut d’Epertise Clinique (IEC) - France Jan 2008
  - 19 women in the age range 18 – 70, with hypersensitive, dry to extra-dry skin.
  - 28 days study on the face compared to a placebo lotion
  - Pectin blend use level- 1.25%

Conclusions:
- A statistical significant decrease of trans epidermial water loss by 20%, showing into evidence a protective effect on the skin and improvement of the skin barrier function.
## Pectin Blend

### Protective Cream

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>QTY (%W/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>q.s. to 100</td>
</tr>
<tr>
<td><strong>Pectin Blend</strong></td>
<td>0.50</td>
</tr>
<tr>
<td>Gellan gum</td>
<td>0.07</td>
</tr>
<tr>
<td>Glycerin</td>
<td>4.00</td>
</tr>
<tr>
<td>Butyrospermum Parkii (Shea butter)</td>
<td>0.50</td>
</tr>
<tr>
<td>Caprylic capric tryglyceride</td>
<td>8.00</td>
</tr>
<tr>
<td>Cetearyl alcohol</td>
<td>1.00</td>
</tr>
<tr>
<td>Cetyl palmitate</td>
<td>0.50</td>
</tr>
<tr>
<td>Tocopheryl acetate</td>
<td>0.20</td>
</tr>
<tr>
<td>Macadamia Integrifolia seed oil</td>
<td>4.50</td>
</tr>
<tr>
<td>Cetearyl olivate (and) Sorbitan Olivate</td>
<td>4.00</td>
</tr>
<tr>
<td>Preservative</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Please contact us for detail information on formulation
Xanthan gum

- Robust and versatile thickener/stabilizer Stabilizing and thickening challenging systems. Superior green ingredient compatibility

- Applications:
  - Purifying Clay pack
  - Peppermint Foot scrub
  - Body polish
  - Zinc oxide Sunscreen
  - Natural Luffa Body wash
  - Depilatory Lotion for legs
  - Aloe vera cooling gel
  - Glycolic acid serum
  - Energizing vitamin serum
  - Relaxing Body massage cream
Xanthan gum

- **INCI**: Xanthan gum
- **Fermentation derived** (*Xanthomonas campestris*)
- **Cellulose backbone with three sugar side chain**

**Rheology & Key attributes:**
- **Pseudoplastic rheology**
- Forms networks (reversible) in aqueous systems (at rest)
- Smooth xanthan gum Reduced extensional viscosity-Low stringiness
- Stable in extreme pH conditions (pH 3-11): eg AHA cream
- Stable in high electrolyte medium: Clay masks,
- Good Surfactant compatibility:
- Functional in difficult to thicken surfactant systems
- Provides improved thermal stability: e.g. sunscreens
- Can provide foam stability
Xanthan gum with reduced stringiness

Generic XG          Smooth flow xanthan
Xanthan gum pH stability

Xanthan gum temperature stability

Figure 2: KELTROL® CG Temperature Stability
1.0% KELTROL® CG Concentration
## Xanthan gum

**Luffa exfoliating face wash with “green” surfactants**

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>QTY (%W/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>q.s. to 100</td>
</tr>
<tr>
<td>Smooth flow xanthan gum</td>
<td>0.80</td>
</tr>
<tr>
<td>Carrageenan</td>
<td>0.40</td>
</tr>
<tr>
<td>Glycerin</td>
<td>5.00</td>
</tr>
<tr>
<td>Disodium Cocoyl Glutamate</td>
<td>12.00</td>
</tr>
<tr>
<td>Decyl glucoside</td>
<td>10.00</td>
</tr>
<tr>
<td>Sodium cocoyl apple amino acids</td>
<td>4.00</td>
</tr>
<tr>
<td>Cocamidopropyl betaine</td>
<td>10.00</td>
</tr>
<tr>
<td>Aloe barbadensis leaf juice</td>
<td>4.00</td>
</tr>
<tr>
<td>Preservative</td>
<td>q.s.</td>
</tr>
<tr>
<td>Luffa Cylindrica fruit</td>
<td>0.20</td>
</tr>
<tr>
<td>Citric acid</td>
<td>q.s. to adjust pH</td>
</tr>
<tr>
<td>Color/Fragrance</td>
<td>q.s.</td>
</tr>
</tbody>
</table>

Please contact us for detail information on formulation
Gellan gum

- Water like gels with light skin feel. Suspension in low viscosity systems

Applications
- Natural day cream
- Refreshing milk
- Revitalizing under eye serum
- Calming Mist with Vitamins
- Sunscreen spray
- Light Moisturizer for oily skin
Gellan gum

- INCI: Gellan gum
- Fermentation derived (Sphingomonas elodea)
- Four sugar repeating unit, with acyl groups
- Types
  - Low acyl: Hard/brittle gels-Transparent (Forms gels by cations-Na, Ca, Mg, K)
  - High acyl: Soft/elastic gels Opaque

Rheology & Key attributes:
- Provide true yield: Form long term interactions (network) in water system
- Ability to form Fluid Gels: Low viscosity sprayable liquid with suspension.
- Excellent Sprayability-Shear thinning & low extensional viscosity
- Provides excellent suspending & stabilizing properties
- Low use levels for fluid gels - 0.02-0.2% use-level
- Light skin-feel and Non-stringy flow
- Good thermal and pH stability and salt compatibility
Structure / function – network properties

Cooling
Heating

LA gellan gum

HA gellan gum
Gellan gum fluid gel
Viscosity dependent on shear rate - low viscosity spray
## Gellan gum

**Calming spray- Kelcogel CG-LA**

<table>
<thead>
<tr>
<th>INGREDIENTS</th>
<th>%QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Qs to 100</td>
</tr>
<tr>
<td>Gellan gum</td>
<td>0.075</td>
</tr>
<tr>
<td>Xanthan gum</td>
<td>0.04</td>
</tr>
<tr>
<td>Glycerin</td>
<td>0.50</td>
</tr>
<tr>
<td>Water and Calcium chloride</td>
<td>0.70</td>
</tr>
<tr>
<td>Rosa Gallica Flower Extract</td>
<td>1.00</td>
</tr>
<tr>
<td>Panthenol</td>
<td>0.20</td>
</tr>
<tr>
<td>Aloe barbadensis leaf juice</td>
<td>10.00</td>
</tr>
<tr>
<td>Preservative</td>
<td>q.s.</td>
</tr>
<tr>
<td>Beads</td>
<td>q.s.</td>
</tr>
</tbody>
</table>

Please contact us for detail information on formulation
Carrageenan

- Texturizer with unique skin feel. Innovative product forms - Gelled systems, gel films are possible

**Applications:**
- Seaweed gel mask
- Hydrating Body wrap gel
- Calming Gelled mask
- Cooling eye patch
- Elegant body butter
- Cool Shower jellies
- Natural Serum-organic extracts
Carrageenan

- **INCI**: Chondrus crispus (Carrageenan)
- Extracted from red seaweeds
- Partially sulfated poly D-galactose

**Types**
- Kappa: High strength, transparent gels require ions
- Iota: Elastic, transparent gels; require ions
- Lambda: For viscosity only

**Rheology & key attributes:**
- Gel forming carrageenan can provide structure/shape retention
- Iota Gels are pseudoplastic/thixotropic and impart lubrication
- Combination of Iota carrageenan + smooth flow xanthan for improved skin feel & texture
- Good water binding property and syneresis control
- Kappa carrageenan for Gelled systems-
  - Shower gels, Face mask gels
- Varied range of texture possible
Gelling mechanism

Solution → Gel 1 → Gel 2

Lambda → Aggregation → Kappa

Cooling
Texture variation with iota carrageenan

Seaweed gel Mask

Smooth flow xanthan gum

Smooth flow xanthan + iota carrageenan
Texture variation with Kappa Carrageenan

Gelly Shower gel

Gel films
## Seaweed – Minerals Gel Mask

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<tr>
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<tr>
<td>Water</td>
<td>Qs to 100</td>
</tr>
<tr>
<td>Smooth flow Xanthan gum</td>
<td>1.50</td>
</tr>
<tr>
<td>Iota Carrageenan</td>
<td>0.50</td>
</tr>
<tr>
<td>Arnica Montana Flower Extract &amp; Algae Extract</td>
<td>0.50</td>
</tr>
<tr>
<td>Aloe Barbadensis Leaf Juice</td>
<td>2.00</td>
</tr>
<tr>
<td>Sodium hyaluronate</td>
<td>1.00</td>
</tr>
<tr>
<td>Ginkgo biloba extract</td>
<td>1.00</td>
</tr>
<tr>
<td>Algae extract</td>
<td>1.50</td>
</tr>
<tr>
<td>Glycerin</td>
<td>2.00</td>
</tr>
<tr>
<td>Sea salt</td>
<td>1.00</td>
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<tr>
<td>Preservative</td>
<td>q.s.</td>
</tr>
<tr>
<td>Fragrance</td>
<td>q.s.</td>
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<tr>
<td>Parsley Leaf</td>
<td>q.s.</td>
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</tbody>
</table>

Please contact us for detail information on formulation
Carboxymethyl cellulose

- Viscosifier with smooth texture. Imparts richer skin feel.
- Film delivery concept

Applications
- Rich cream for hand and feet
- Nourishing serum for dry skin
- Luxurious Body cream
- Smoothening Body lotion
- Acne treatment Films
- Age-spot treatment Film
- Ready to use face mask film
Carboxymethyl cellulose

- **INCI:** Cellulose gum
- Derived from Cellulose
- Carboxymethyl esters of anhydroglucose units
- **Types - Vary by:** Molecular weight
- Degree of substitution
- Cross-linked

**Rheology & Key attributes:**
- Low viscosity grades- Newtonian flow (eg. Serum, lotion)
- Provides thickening-To achieve correct level of high shear viscosity
- Promotes a richer skin feel
- Provides Smooth, non gelled, thick viscosity- during pouring
- Good Binding properties-Toothpaste
- Excellent solubility and film formation properties.
- Lower molecular weight products for film delivery systems
Typical lab preparation of a film

Solution

Pigment added

Draw down bar and solution

Draw down Bar close up

Film nearly formed

Film done!
Combining green polymers for Functional & Sensorial benefits

- Improved skin feel textures with superior green ingredient compatibility: Xanthan + carrageenan (Seaweed gel mask, Luffa Face wash)
- Skin protection & Unique Skin Feel: Pectin + Gellan gum (Protective Cream)
- Light Natural Feel with smooth texture: Gellan gum blend (Natural Day cream)
- Natural Control: Gellan gum +xanthan (Calming Spray), Microfibrous cellulose blend (Lemongrass body wash)
- Polyacrylate alternative: CP KELCO polymer blend (Hair Gel)
New polymer blend for- Polyacrylate-like texture

- The new polymer-blend has ability to provide viscosity, smooth flow, and a “Gel” like texture
- It provides even- application, and a “Non-stringy” flow
- It has broad pH stability (4-10)
- Clear formulations are possible
- Please stop by at booth to check the texture
Thank you for your time!

Please contact Jo-Ann Wipperman at jwipperman@lvlomas.com for more information on green polymers (CP Kelco products)