Chitosan - the Sustainable Active Ingredient for Skin and Hair Care
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Natural ingredients are our strength

The Seagarden group is a Norwegian company supplying 100% natural marine products to the global markets. Its daughter company Chitinor AS has established a comprehensive know how on extraction and processing of bioactives from the Atlantic Ocean. Chitosan is a naturally occurring derivate of Chitin.

This renewable biopolymer with outstanding properties is extracted from a sustainable source, the shells of the cold water shrimp *Pandalus borealis*.

Our Chitosans combine the benefit of a high-performing marine bioactive with the advantages of a sustainable ingredient for your valuable cosmetic applications.
Skin is another of nature’s masterpieces, remaining soft and smooth, firm and supple throughout youth. But life takes its toll, and passing years are generally written on the skin. Nature provides beauty, but only limited resistance to environmental influences. Now Chitinor’s Chitosans pick up where nature leaves off. This multifaceted biopolymer of marine origin protects and cares for the skin, it is highly skin-compatible, styles hair without stickiness and is gentle on the environment.

Not just any Chitosan will do. Raw materials should always be from a single source and processed with advanced techniques in order to achieve the consistent high quality of the Hydamer™ range of different Chitosan products - perfectly in line with the exacting demands of the cosmetic industry.
Our film-sensation:
Special effects for every skin

The idea is ingeniously simple: A fine, natural film prevents loss of moisture and elasticity. Thanks to a high molecular biopolymer taken from the marine world. This brilliant active ingredient, Hydamer™ CMF/CMFP with a molecular weight of up to five million g/mol, protects the face and body with a film whose soothing effects can truly be felt. Hydamer™ CMF/CMFP also stands out thanks to its excellent skin compatibility.

EFFECTS

> Film-formation (non-occlusive), substantivity
> Increase of water binding capacity
> Increase of water resistance of UV-filters
> Increase of skin flexibility, elasticity, smoothness
> Improvement of sensory parameters
> Reduction of skin irritation

CLAIMS

> Protective layer formation
> Moisturizer effect, firming of the skin
> Improved sun protection
> Softness, suppleness
> Skin sensation
> Skin compatibility
Protection against moisture loss

Studies of transepidermal water loss (TEWL) have shown that Hydamer™ CMF/CMFP offers the same outstanding Moisturizing performance as hyaluronic acid and native collagen.

Soft and Smooth

Supleness of the skin is determined by measuring torsion, as a function of deformation. Areas of skin treated with a placebo formulation exhibit high torsion values, indicating reduced elasticity. This test result correlates with TEWL findings. Increased water loss causes the skin to dry out; it becomes rougher, losing flexibility and suppleness. When Hydamer™ CMF/CMFP is added to the formula, torsion values are reduced. Skin treated with Hydamer™ CMF/CMFP becomes noticeably softer and around 80% smoother than untreated skin.

Skin compatible and non-irritating

Hydamer™ CMF/CMFP are substances of extreme purity offering excellent skin compatibility performance. In a human patch test conducted under occlusive conditions, the formulation containing Chitosan substantially reduced skin reactions. Hydamer™ CMF/CMFP can be added to cosmetic products to improve dermatological compatibility and contributes to the product’s safety.

Safety in Sun Protection

As a cationic, substantive biopolymer, Hydamer™ CMF/CMFP increases the water resistance of sunscreens. After being rinsed with water, the formulation containing Hydamer™ CMF shows 74% water resistance, some 17% higher than the value for the placebo. The high molecular weight Hydamer™ CMF/CMFP film protects the skin against moisture loss and improves UV filter adhesion. The filter is more difficult to rinse off, so sweat and water have no effect. This level of performance makes Hydamer™ CMF/CMFP especially suited to water-proof concepts.

Sensory parameters

The findings of in-vitro studies regarding moisture binding capacity and elasticity are unequivocal. The formulation with Hydamer™ CMF obtained the best results in a panel test of the following assessment criteria:

- Application properties
- Distribution
- Penetration properties
- Perceptible, long term enhancement of skin sensation

Water resistance according to the Australian/New Zealand standard in %

<table>
<thead>
<tr>
<th></th>
<th>Before watertreatment</th>
<th>After watertreatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Hydamer™ CMF</td>
<td>74%</td>
<td>57%</td>
</tr>
<tr>
<td>Placebo</td>
<td>57%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Twistometry measurement (In Vitro) Improvement in skin smoothness in %

<table>
<thead>
<tr>
<th></th>
<th>Before watertreatment</th>
<th>After watertreatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Hydamer™ CMF</td>
<td>83%</td>
<td>60%</td>
</tr>
<tr>
<td>Placebo</td>
<td>60%</td>
<td>40%</td>
</tr>
</tbody>
</table>
A modern deodorant is expected to perform several tasks at the same time: It should provide longlasting, all-day protection while imparting a feeling of freshness and cleanliness, and should also be skin-compatible and mild. Hydamer™ DCMF, the capable marine active ingredient, enables modern deodorants to satisfy these demands. This ingredient provides long-lasting freshness from the sea and exhibits outstanding skin-care properties. Hydamer™ DCMF is a marine deodorizing agent and care-factor in one.

**EFFECTS**

> Inhibition of bacterial growth
> Enhancement of perfume adhesion
> Reduction of skin irritation
> Improvement of sensory parameters
> Modular active substance

**CLAIMS**

> Antimicrobial efficacy
> Improved odor masking, prolonged fragrance retention
> Mildness, skin compatibility
> Skin sensation
> Tailor-made concepts
1. Perfect Stop Odor Principle

**Mechanisms of odor formation**

<table>
<thead>
<tr>
<th>Sweat secretion</th>
<th>Prevention</th>
<th>Active Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reduction</td>
<td>e.g. Aluminium chlorohydrate</td>
</tr>
<tr>
<td>Coryne bacteria growth</td>
<td>Inhibition of Coryne bacteria growth</td>
<td>Hydamer™ DCMF</td>
</tr>
<tr>
<td>Activation of enzymes</td>
<td>Inhibition of enzymes</td>
<td>e.g. Triethyl Citrate</td>
</tr>
<tr>
<td>Enzymatic degradation of sweat</td>
<td>Odor</td>
<td>Perfume + Hydamer DCMF</td>
</tr>
</tbody>
</table>

**Evaluation of Odor Reduction**

The effectiveness of a Hydamer™ DCMF containing formulation (without added perfume) against body odor was evaluated in comparison with that of a strongly odor reducing standard formulation comprising of aluminum chlorohydrate and triclosan. It was found that a formulation with Hydamer™ DCMF demonstrated a comparable to slightly better performance regarding customer’s demands for modern deodorants. Hydamer™ DCMF also offers ideal protection against odor formation at reduced application concentrations of the individual active ingredients.

**Deodorant Effect**

In a comparative test of a formulation containing Hydamer™ DCMF (0.1 %) and a formulation containing triclosan (0.3 %), which is generally regarded as an efficient antimicrobial active ingredient, the following evaluation criteria were used: Deodorant effect, sensation, stickiness and skin compatibility. The deodorant effect and skin compatibility of the formulation containing Hydamer™ DCMF was rated better. In addition to the deodorant effect, Hydamer™ DCMF reduced the irritation potential of this formulation and thus improved its dermatological compatibility.

**The Perfect Stop Odor Principle**

To efficiently stop unpleasant body odor, every single component which contributes to odor formation should be inhibited. The mechanism of odor formation can be subdivided into five steps (see overview 1). A modular deodorant composition can inhibit undesired sweat degradation in the early stadium before odor occurs. Hydamer™ DCMF acts as the key active ingredient which prevent bacterial growth. The advantage of the modular concept is the synergistically deodorizing effect of the combination of Hydamer™ DCMF with the antiperspirant, e.g. aluminum chlorohydrate, and an natural enzyme inhibitor, e.g. triethyl citrate. Odor formation is thus counteracted by up to four mechanisms. This principle can be used to provide particularly strong, long lasting protection.

**Scent Adhesion**

The odor intensity and adhesion of perfume oil in a deodorant brand formulation with and without the addition of Hydamer™ DCMF were evaluated in a comparative test by a panel, consisting of fragrance and laboratory specialists. The odor intensity and adhesion of the formulation containing Hydamer™ DCMF were rated significantly better by both groups.
For perfect styling and healthy hair

In many cultures, hair is regarded as a symbol of strength. But often enough, it could use more strength of its own. Not only can hair be left dry, dull and split by environmental influences – it also needs extra help to keep its shape. Hydamer™ HCMF gives hair the additional strength it needs, coating individual strands with a flexible, homogeneous, non-flaking film for perfect styling and protection from external influences. This all-in-one product for shape, protection and care opens up a whole new dimension in styling. The results are excellent in terms of appearance and feel: shiny hair, healthy ends, perfect shape and hold.

**EFFECTS**

- Formation of flexible, homogeneous, crack free film at low concentrations
- Hair does not stick together
- Easily washed out
- Low sensitivity to atmospheric moisture
- Reduced electrostatic charge
- Protective film, hair fibers do not dry out
- Good skin compatibility
- Readily biodegradable

**CLAIMS**

- Styling without "dandruff effect", hold and elasticity without added heaviness
- Natural, flexible hold without stickiness
- No build-up effect
- All-weather styling product
- Reduced fly-away effect
- No broken hairs, no split ends
- Care for the scalp
- Environmentally friendly
Bounce and Elasticity

Coated with Hydamer™ HCMF’s protective layer, hair has added bounce and elasticity you can both see and feel. These properties are confirmed by the results of objective test methods. Products that improve bounce are characterized by an ability to increase the initial amplitude and the elongation work as well as the oscillation frequency and damping values.

Styling without Flaking

Hydamer™ HCMF and PVP/VA copolymers both form films of comparable hardness after drying. However, varying properties can be observed in these films. While cracks develop in PVP/VA films during drying, Hydamer™ HCMF forms a homogeneous, stress-free film: There is no visible difference in its performance even after 10 times combing.

Homogeneous films offer the following benefits:

- No peeling or flaking of the filmforming substance, and thus no visible “dandruff effect”, just increased film longevity
- Moisturizing effect
- Less environmental odor absorption
- Hair gloss
- Anti-Frizz

Crack formation in PVP/VA films can be counteracted by adding small amounts of Hydamer™ HCMF. A mixing ratio of 1:0.05 is sufficient to bring about a considerable reduction in crack formation.

A mixing ratio of 1:0.1 results in films that are absolutely homogeneous and dry without cracking. Hydamer™ HCMF enhances film elasticity and prevents polymer films from drying out and cracking.

### Bending strength in Correlation to Concentration

For calculation of required Hydamer™ HCMF amount

<table>
<thead>
<tr>
<th>Bending Strength %</th>
<th>250</th>
<th>200</th>
<th>150</th>
<th>100</th>
<th>50</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCMF/PVP/VA</td>
<td>0/0</td>
<td>1/1</td>
<td>2/2</td>
<td>3/3</td>
<td>4/4</td>
<td>5/5</td>
</tr>
</tbody>
</table>

For example: to replace 6.5% PVP/VA in a formulation use 0.45% Hydamer™ HCMF.

Note the different concentration ranges of Hydamer™ HCMF and PVP/VA.
Ideal for every kind of weather

The effectiveness of products at high atmospheric humidity can be measured by determining curl retention. The less sensitive the reaction of polymers to high humidity, the greater the curl retention. Curl retention expresses the relationship between curl length both before and after the exposure period. In addition to being highly effective at low concentrations, Hydamer™ HCMF exhibits only slight sensitivity to atmospheric humidity. This makes it ideal for enhancing the performance of all weather products.

Dry combing is done to assess styling performance. Polymeric film-forming agents generally bring about a concentration dependent increase in combing work values. But only 0.1% Hydamer™ HCMF generally achieves substantially better values than those obtained with a much higher concentration of conventional film-forming agents. The result is excellent styling performance. Dry combing work can also be used to demonstrate whether the styling effect is completely reversed by a shampoo treatment. Hydamer™ HCMF washes out easily, which prevents any build-up effect.

Styling power

Bending strength shows the strength of a film under physical strain. Hydamer™ HCMF offers bending strength around 5-12.5 times that of comparable products, depending on application concentration.

All-round protection and care

Another test involves simulated splitting under in-vitro conditions. Treatment with a rinse containing 0.5% Hydamer™ HCMF remarkably reduces the rate of splitting. This is a vivid illustration of Chitosan’s protective action and proves that Hydamer™ HCMF is qualified to prevent split ends. On top of that, a single rinse with a product containing 0.5% Hydamer™ HCMF revealed the agent’s significant repair effect.

Dry Combability of Hair Bundles

Combining force in mJ

<table>
<thead>
<tr>
<th>untreated</th>
<th>with 0.1% Hydamer™ HCMF</th>
<th>with 0.1% Hydamer™ HCMF + 1 x Shampoo</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Curl Retention of Styling Mousse Products for Strong Hold

<table>
<thead>
<tr>
<th>Hydamer™ HCMF formula</th>
<th>1% Hydamer™ HCMF</th>
<th>Benchmark Europe II PVP/VA</th>
<th>Hydamer™ HCMF formula</th>
<th>Asian hair</th>
<th>Benchmark Asia</th>
<th>Asian hair</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>0</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

45% humidity, 24h
96% humidity, 0.5h
96% humidity, 10h
### Technical Data

<table>
<thead>
<tr>
<th></th>
<th>Hydamer™ CMF</th>
<th>Hydamer™ CMFP</th>
<th>Hydamer™ DCMF</th>
<th>Hydamer™ HCMF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active substance</strong></td>
<td>approx. 1% (in 0.4% Glycolic acid solution)</td>
<td>approx. 95% (Powder)</td>
<td>approx. 95% (Powder)</td>
<td>approx. 95% (Powder)</td>
</tr>
<tr>
<td><strong>NCI Name</strong></td>
<td>Chitosan Glycolate</td>
<td>Chitosan</td>
<td>Chitosan</td>
<td>Chitosan</td>
</tr>
<tr>
<td><strong>Application concentration</strong></td>
<td>0.05 - 0.15% AS</td>
<td>0.05 - 0.15% AS</td>
<td>0.05 - 0.2% AS</td>
<td>0.2 - 15% AS</td>
</tr>
<tr>
<td><strong>Degree of Deacetylation</strong></td>
<td>min. 80%</td>
<td>min. 80%</td>
<td>min. 80%</td>
<td>min. 80%</td>
</tr>
<tr>
<td><strong>Molecular weight</strong></td>
<td>500,000 - 5,000,000 g/mol</td>
<td>500,000 - 5,000,000 g/mol</td>
<td>300,000 - 2,000,000 g/mol</td>
<td>50,000 - 1,000,000 g/mol</td>
</tr>
</tbody>
</table>

### Application
- Facial Care
- Body Care
- Sun Care
- After-Shaves
- Facial Cleansers
- Decorative Cosmetics
- Deoproduts for the armpits
- Deoproduts for foot care
- Hair setting preparations
- Hair gels, styling mousses
- Styling creams and waxes
- Hair-tip fluids
- Anti-dandruff preparations
- Hair tonics
- Hair conditioner

### Formulation
- Emulsions
- Fluids
- Tonics
- Surfactant products, non ionic
- Pump-sprays
- Roll-on
- Emulsions
- Ethanol-containing formulations (<60%)
- Pure aqueous formulations
- In combination with propellants
- In combination with amphoteric, nonionic and cationic surfactants
- In combination with synthetic polymers preparations
- Pump-action-sprays
- Emulsions

### Ecological Data Hydamer™ CMF/CMFP/DCMF/HCMF (1% solution)

- **Biodegradability:** BODIS-Test (ISO 10634): >70% readily biodegradable
- **Fish Toxicity:** (semi-static, 96 h, ISO 7346/2, OECD 203) LC50 10,000 mg Product/l
- **Bacteria Toxicity:** (OECD 209): EC50 3,000 mg Product/l

### Advantages for handling and storage:

- Chitosan is compatible with alcohol (<60%), salts and resistant to high temperatures.

### Molecular Weight Distribution Hydamer™ CMF/CMFP/DCMF/HCMF

- **Hydamer™ DCMF:** 2,000,000 - 500,000 g/mol
- **Hydamer™ CMF/CMFP:** 5,000,000 - 500,000 g/mol
- **Hydamer™ HCMF:** 1,000,000 - 50,000 g/mol
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