Sodium Carboxymethylcellulose

The Ideal Hydrocolloid for Dairy Applications

WALOCEL™ C
Contents

Dow Wolff Cellulosics ............................................... Page 4
Structure of WALOCEL™ C ........................................ Page 7
Properties of WALOCEL™ C ...................................... Page 8
Unique performance of CMC ..................................... Page 14
The advantages at a glance ...................................... Page 20
Potential for WALOCEL™ C in dairy products ........ Page 22
Applications and recommendations ....................... Page 24
Acidified dairy drinks and fruit preparations ........... Page 26
Sweet dairy products ............................................. Page 28
Cocoa drinks and instant milk mix drinks ............... Page 30
Cheese products .................................................. Page 32
Product range ..................................................... Page 34
Packaging & storage ............................................ Page 36
Viscosity ......................................................... Page 37
Food & Nutrition ............................................... Page 38

ADDVALUE line

PREMIUM QUALITY FOR IMPROVED PRODUCTS
PLUS CUSTOM-FOCUSED TECHNICAL SERVICE
Dow Wolff Cellulosics has been producing cellulose ethers for more than forty years. With its experience and state-of-the-art production facilities Dow Wolff Cellulosics is among the world’s leading suppliers of cellulose derivatives. This is the firm footing on which Dow Wolff Cellulosics develops and produces products with which its customers can achieve lasting success.

Cellulose derivatives with brand quality status

The development, manufacture and marketing of cellulose derivatives are the core competencies of Dow Wolff Cellulosics.

- The highly purified cellulose derivatives carboxymethylcellulose (CMC) and hydroxypropylmethylcellulose (HPMC) are used in food products, cosmetics and pharmaceuticals. At its state-of-the-art pilot plant, Wolff Cellulosics develops new products and technologies for the production and processing of derivatives of the renewable raw material cellulose.

- Dow Wolff Cellulosics’ production facilities are among the most modern in the world thanks to continual investment in plant and equipment, products and processes, thus serving customers with dependable supplies of consistently high-quality products.

- Through in-depth research and development Dow Wolff Cellulosics offers constantly upgraded products and competent technical advice.

- Our commercial and technical marketing experts provide direct support to promote your business success.

- With its global logistics network Dow Wolff Cellulosics assures reliable and flexible supplies around the world.

- Dow Wolff Cellulosics is totally committed to quality management. Our in-house testing laboratories monitor the production processes 24/7, and in close collaboration with production personnel they assure optimal product quality. Dow Wolff Cellulosics complies with ISO 9001:2000 standards.

For more information about Dow Wolff Cellulosics log onto our website www.dowwolffcellulosics.com or call our customer service department: phone +49 5161 443443.
Sodium carboxymethylcellulose is produced by etherification of cellulose from renewable resources (wood). The hydroxyl groups of the D-glucose chain are partly substituted with carboxymethyl groups to obtain a water-soluble polymer (cellulose ether) with defined functions.

**WALOCEL™ C products are defined by their**

**Degree of substitution (DS)**

WALOCEL™ C grades have a DS of between 0.65 and 0.95.

**Substituent distribution**

The distribution of the carboxymethyl groups along the cellulose chain is controlled by the production process. The substituents can be arranged either evenly or unevenly along the cellulose backbone.

**Degree of polymerization**

**(cellulose chain length)**

The degree of polymerization (DP) determines the viscosity development of the CMC solution. WALOCEL™ C grades cover a wide viscosity range from water-thin to pasty (at 1% CMC concentration in water).

Both low-viscosity CMC grades with only stabilizing properties and medium-viscosity CMC grades which also cause an increase in viscosity are used in dairy products.

**Granulometry**

WALOCEL™ C grades are available with a variety of particle sizes and distributions through milling. Depending on the way CMC is incorporated into the recipe and the desired food processing method, the best option may be a granulate material, a powder or a fine powder.

**Chemical structure of CMC**

![CMC molecule (polyanionic structure)](image)
Properties

Impact of heat on CMC

► With increasing temperature the viscosity of the CMC solution decreases (reversible behavior).

► At temperatures above 90 °C all CMC solutions are thin-flowing.

► Reversible process: when the temperature of the CMC solution is reduced, the viscosity fully returns to its initial value.

► No destruction or decomposing of CMC after cooking in acid systems (pH > 3.5).

► No heat gelation, no flocculation.

► Reversible thinning through heat treatment enables rapid heat transfer during the pasteurization or sterilization process. Dairy products and sensitive ingredients therefore undergo gentle treatment.

Change of viscosity by increasing temperature

Figure 2: Reversible viscosity loss during heating
(WALOCEL™ CRT 100/00 GA, 2% in water, Brookfield LVT, speed 6 rpm, spindle no. 3)
Properties: Viscosity
Impact of CMC concentration on viscosity

- Rule of thumb
  Doubling the amount of CMC will increase the viscosity in water by a factor of 10.

Impact of shear force on CMC, reversible shear thinning

- Mechanical forces such as stirring and homogenization decrease the viscosity due to shear stress (pseudoplasticity). This effect is completely reversible in a pH range from 3.8 - 7.0. After a rest time the viscosity returns to its initial value (thixotropy).

Relation between CMC concentration and viscosity

![Figure 3: Concentration versus viscosity of different CMC grades (in water at 15°C, Brookfield LVT)](image)

![Figure 4: Effect of shear rate — change of viscosity as a function of time with and without shear stress](image)
## Impact of pH value on CMC

- Good stability over a wide pH range – best effects of CMC from pH 3.8 - 7.0.
- Below pH 3.8 the functionality of CMC is still present, but slightly reduced.
- CMC becomes insoluble in systems at pH 3.0 or less.
- In addition, our clear+stable product line produces particularly good results in terms of clear solubility and viscosity, and they remain stable even in highly acidic applications (pH below 3.0).

## Impact of Ca²⁺ ions on CMC

- Generally di- and trivalent metal ions can support the gelling of CMC. Very high concentrations of these metal ions may cause the anionic CMC molecule to flocculate.
- The naturally occurring concentration of calcium ions in milk (1.2 g/l) is not critical with regard to the functioning of CMC.
- For pH neutral dairy products, CMC is not recommendable for the usage as single ingredient due to its Ca²⁺ affinity.

## Effect of CMC on proteins

- The anionic nature of CMC causes interaction with many proteins, thereby forming soluble and stable complexes.
- CMC achieves a permanent stabilizing effect without increasing the viscosity. The stabilization is not the result of gelation.
- CMC solubilizes proteins in the isoelectric pH range and protects proteins against the effects of heat (reduced flocculation due to electrostatic attraction).

## Acid-Stable CMC

**Cellulose Gums**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Properties</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid-Stable CMC</td>
<td><strong>Impact of pH value on CMC</strong></td>
<td><strong>Impact of Ca²⁺ ions on CMC</strong></td>
</tr>
<tr>
<td>Clear+stable</td>
<td>- Good stability over a wide pH range – best effects of CMC from pH 3.8 - 7.0.</td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
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</tbody>
</table>

**Effect of CMC on proteins**

- The anionic nature of CMC causes interaction with many proteins, thereby forming soluble and stable complexes.
- CMC achieves a permanent stabilizing effect without increasing the viscosity. The stabilization is not the result of gelation.
- CMC solubilizes proteins in the isoelectric pH range and protects proteins against the effects of heat (reduced flocculation due to electrostatic attraction).
Figure 5: principle of stabilizing acidic milk protein with CMC

- pH 3.8
- CMC molecules with negatively charged carboxymethyl groups
- Electrostatic attraction
- Protein molecule

CMC molecules with negatively charged carboxymethyl groups
Performance of CMC

The isolectric point of casein is around pH 4.6, and for whey proteins the IEP is between pH 4.2 and 5.1.

Due to its anionic nature, sodium carboxymethylcellulose can interact with caseins in acidic milk systems at pH 3.5 - 5.5, forming soluble complexes that remain stable during heat treatment and storage. Without the addition of CMC the caseins would normally precipitate in this pH range. The cellulose derivative solubilizes proteins in the isoelectric range, i.e. it shifts the proteins’ IEP to lower pH values. Therefore, CMC keeps the proteins in solution at their natural IEP.

Essentially, the reactions of these water-soluble proteins with CMC have ionic mechanisms, but hydrogen bonding, steric effects and Van der Waals forces also have an impact on the system. Furthermore, CMC protects acidic milk proteins against the effects of heat (prevention of flocculation due to steric repulsion).

These properties are exploited in the stabilization of milk drinks made of whey, buttermilk or yogurt and for milk mix beverages with fruit juice.

This solubilizing effect plus CMC’s behavior as a protective colloid for proteins gives CMC a unique performance profile when compared with other hydrocolloids.

Other hydrocolloids such as guar, carrageenans and starches (which are used traditionally in most dairy applications) do not have this heat protecting effect.

The stabilization function of these hydrocolloids is not caused by ionic mechanisms and electrostatic forces. The stability results solely from their impact on the viscosity as a result of gel formation, developing an internal network structure.

These facts explain why dairy products “stabilized” with these alternative polymers can lose their high performance during heat treatment or when concentrated products are diluted. For low-viscosity applications these hydrocolloids are therefore unsuitable.

At a pH below 3.5 clear+stable displays its unique performance.
Performance of CMC

Comparing CMC with other hydrocolloids in acidic milk-based systems

Dairy products stabilized in this way are often pushed to their limits during heating or the dilution of concentrates.

To stabilize acidic dairy beverages by forming soluble complexes, a certain amount of low-viscosity CMC molecules is required – this explains the trend of the curve: compared to guar and locust bean gum a higher concentration of CMC is needed to obtain a stable drink. These two hydrocolloids have an earlier point of “zero separation”. At lower dosages they have a major effect on viscosity and the high viscosity prevents particle separation. This thickening effect makes hydrocolloids unsuitable for low-viscosity applications.

The key argument for CMC as opposed to other hydrocolloids is its behavior as a protective colloid for proteins, safeguarding them from acid and heat. The sensitive acidic milk proteins remain functional and remain in solution under product and processing conditions at which they would otherwise naturally precipitate, forming visible complexes.

Test method:

1. Prepare a dairy drink with 490 g buttermilk + “x” g hydrocolloid + 101 ml water
2. Adjust the solution to pH 4.0 using citric acid (1:1)
3. Homogenize at 250 bar
4. Centrifuge (30 min, 5000 rpm)
5. Measure the volume of the separated whey
Figure 6: Effect of various hydrocolloids on whey separation in acidic dairy drinks.
Behavior of WALOCEL™ C with milk – interaction between CMC and milk proteins (caseins)

Milk is a multidispersion of protein, fat, lactose, minerals and vitamins in water. The oil droplets are surrounded with “membranes” of surface active substances; therefore, milk can be regarded as an oil-in-water emulsion. The proteins are distributed as colloids in the aqueous solution in which the sugar, mineral substances and vitamins are solubilized. Most of the calcium and phosphate is bound to the casein proteins.

The sensitivity of dairy products to heat and pH change is mainly caused by the proteins, especially by the caseins.

Proteins are polymers of amino acids and occur in numerous different forms. Proteins consist of more than twenty different amino acids which are generally covered by the formula $R - CH(-NH2) - COOH$. The character of the protein residue (R) can be aliphatic, aromatic or heterocyclic (with further functional groups).

Amino acids have two characteristic functional groups: the amino group (–NH2) and the carboxylic group (–COOH). In aqueous solutions the amino acids are ions and, depending on their pH value, they can have a positive, neutral or negative net charge (cationic, hermaphroditic or anionic structure).

The amino acid monomers control the properties of the resulting proteins. One of the basic properties is the pH sensitivity of proteins which restricts their water solubility to narrow pH intervals. Milk proteins – caseins and whey protein – have an isoelectric point (IEP). It is defined as the pH value where the solubility is very low and the net charge is zero.
The Advantages

20
Walocel™ C has unique characteristics which make it the ideal hydrocolloid for dairy products

- Controls the rheology or viscosity of aqueous food formulations
- High water binding capacity, reduced syneresis
- Soluble in hot and cold water
- Effective in solutions containing alcohol
- Excellent freeze-thaw stability (crystallization control)
- Good stabilizer
- Protective colloid for proteins
- Film-forming properties (barrier function, mouthfeel enhancer)
- Compatible with other hydrocolloids
- Odorless and no impact on flavor or color
- Solutions are fibre-free and smooth-flowing
- No calories
- clear+stable displays its unique performance also at low pH-values
Potential for Walocel™ C in dairy products

Medium-viscosity milk products

Carboxymethylcellulose (CMC) functions as a thickener and texturizer by increasing the viscosity of inhomogeneous dairy bases. It prevents phase separation and syneresis during storage. Furthermore, CMC supports other gelling agents. The resultant gels have higher elasticity and less shrinkage.

Frozen dairy products

CMC acts as a crystallization control agent. It slows down the crystallization rate and reduces crystal growth. The capacity of CMC covers several (20 and more) freeze-thaw cycles. The sandy mouthfeel in ice cream and other frozen milk desserts is suppressed.

Light dairy products and dietetic foods

CMC is free of known allergens and calories. It is an undigestible carbohydrate which acts as a soluble fiber. In addition, high-viscosity CMC can slow down the speed of glucose resorption, so it can be used as a bulking agent for dietetic products. Replacing sugar and lactose with CMC is a further option. It can also be added as a substitute for fats and oils. Due to its high water retention capability and film forming properties, CMC is ideal for light dairy products with a creamy taste, and therefore for low calorie products with reduced sugar and fat content, increased volume, extended shelf-life and good mouthfeel (low-carb, low-fat).

Aerated dairy products

It ability to stabilize foams without affecting surface tension makes CMC suitable for fixing aerated products. The volume and density of the foam is kept stable (prolonged stand-up).

Nutraceuticals, functional and vegetarian foods

Fiber-enriched products can be produced by adding cellulose derivatives. Medium and long-chain CMC grades are neither resorbed nor metabolized in the human body. CMC is of vegetable origin (wood). Pure vegetarian products can be produced by simultaneously using CMC as a substitute for milk proteins and milk fat to create dairy fat mimetics.
Due to its specific characteristics, WALOCEL™ C can improve almost any liquid and medium-viscosity dairy product.

## Fields of Application

### Applications

- ph-neutral
- Neutral milk mix drinks such as cocoa drinks
- Acidified milk drinks (made from yogurt, whey, kefir or buttermilk)
- Instant milk mix drinks
- Spoonable dairy desserts
- Ice cream and frozen milk products
- Fermented products such as yogurt (post-fermentative addition)
- Cheese spreads – processed cheese and fresh cheese preparations

### Easy-to-use WALOCEL™ C

- Added purely as a powder or as an aqueous solution directly to the white dairy product (after fermentation)
- Added via special preparations such as spicy pastes or fruit preparations (adding CMC as a dry blend with other powder ingredients like sugar, salt etc. or as a predispersion in oil)
Recommendations

Fields of Application
Acidified dairy drinks with a fruit taste

Acidified dairy drinks with a fruit taste

Low-viscosity WALOCEL™ C grades improve the quality of thin-flowing dairy products.

Benefits

▸ Consistency control with only slight impact on viscosity

▸ Stabilization of solids
   (fruit particles and milk protein), no separation

▸ Enhanced mouthfeel

Fruit preparations for low-viscosity and medium-viscosity dairy products

Addition of CMC as fruit preparation

The WALOCEL™ C grade determines the final viscosity as well as the type of stabilization (by electrostatic attraction and additionally by viscosity increase).

To stabilize beverages, low-viscosity CMC is used (recommendation: WALOCEL™ CRT 30 or 100 GA/PA, concentration in the final beverage at least 1.5 % CMC).

Desserts are ensured the right spoonability and shelf-life by adding medium-viscosity CMC (WALOCEL™ CRT 2000 or 20000 PA 07, dosage 1 - 2 % in the fruit preparation).

Alternatives as dairy base

Alternative as dairy base

Fruit preparations for low-viscosity and medium-viscosity dairy products

Formulation for fruit preparation (~ 40 ° Brix)

Mashed fruits (fresh or frozen)  50.0 %
Sugar  35.0 %
Water  10.0 - 14.0 %
Citric acid (1:1)  – to adjust to pH 3.9 ± 0.2  (quantum satis)
WALOCEL™ CRT 30/100 GA  
(drinks clear+stable 30/100 PA  min. 5.0 %
WALOCEL™ CRT  
2000/20000 PA 07 (desserts)  
clear+stable 2000 PA  1.0 - 2.0 %
Addition of fruit preparation  1.0 - 25.0 %
Fruit preparations for low-viscosity and medium-viscosity dairy products

Recommendations

Acidified dairy drinks with a fruit taste
Recommendations
## Sweet Dairy Products

<table>
<thead>
<tr>
<th>Applications</th>
<th>WALOCER™ CRT/ clear+stable (c+s)</th>
<th>Concentration (in the end-product)</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buttermilk &amp; yogurt drinks, other acidic dairy drinks</td>
<td>2000/20000 GA/PA 07 clear+stable 2000 PA clear+stable 100 PA 100 GA/PA</td>
<td>0.2 - 0.5 % 0.2 - 0.4 % min. 1 % 0.2 - 0.5 %</td>
<td>Thickener, protein stabilizer</td>
</tr>
<tr>
<td>Whey drinks</td>
<td>30/100 GA clear+stable 30/100 PA</td>
<td>min. 1.5 %, addition via fruit prep, (approx. 20 %), FP with min. 5 %</td>
<td>Stabilizer, consistency provider, mouthfeel enhancer</td>
</tr>
<tr>
<td>Chocolate milk and cocoa drinks</td>
<td>100 PA 2000/20000 PA 07</td>
<td>1.0 % + 0.04 % K-carrageenan (refined) 0.2 - 0.4 % + 0.04 % K-carrageenan (refined)</td>
<td>Stabilizer, fat replacer, mouthfeel enhancer</td>
</tr>
<tr>
<td>Milk desserts</td>
<td>2000 GA/PA 07 10000 GA/PA 20000 GA/PA 07</td>
<td>0.2 - 0.4 %</td>
<td>Thickener, consistency provider</td>
</tr>
<tr>
<td>Milk mix products</td>
<td>30000 GA/PA</td>
<td>0.1 - 0.5 %</td>
<td>Thickener, texturizer</td>
</tr>
<tr>
<td>Ice cream</td>
<td>Medium-viscosity CMC: 2000 PA 07 - 30000 PA</td>
<td>0.02 - 0.5 %</td>
<td>Crystallization control, mouthfeel enhancer</td>
</tr>
</tbody>
</table>

*Figure 7: Guidelines for WALOCER™ C and clear + stable grades and concentrations in dairy applications*
Cocoa Drinks
Instant milk mix drinks

Cocoa drinks

Low-viscosity CMC grades stabilize ready-to-drink beverages with a high solids content.

Benefits

- Viscosity control
- Stabilization of particles at hot or cold temperatures, prevention of syneresis and sedimentation
- Improved body and mouthfeel
- Fat-reduced applications with full taste

Instant milk mix drinks

Medium-viscosity CMC grades are added to stabilize powder blends for instant milk-based beverages.

Benefits

- Cold water solubility and stability at cold temperatures
- Prevention of curdling (milk)
- No sedimentation of solids and no cream separation
- Enhanced mouthfeel

Formulation

(A) Composition of the dry powder blend
- Skimmed milk powder: 52.5 - 53.2 %
- Sugar: 36.0 %
- Cocoa powder (deoiled): 10.0 %
- WALOCETM CRT 2000/20000 PA 07: 0.8 - 1.5 %

(B) Preparation of the beverage
- Powder blend (A): 14.0 - 18.0 %
- Water (cold or hot): 82.0 - 86.0 %

Recommendations

Cocoa Drinks
Instant milk mix drinks
Recommendations

In cheese products such as processed cheese and fresh cheese preparations medium-viscosity WALOCEL™ C grades provide a great deal of benefits.

**Processed cheese spreads** can be improved by adding 0.5 - 0.8 % WALOCEL™ CRT 20000 PA 07 or WALOCEL™ CRT 30000 PA. The water content can be increased by 5 - 10 %, while the amount of added fat or butter can be reduced. Ingredients such as whey powder are partially or completely replaceable. In combination with classic gel-forming hydrocolloids, various texture profiles can be achieved.

Fresh cheese preparations with standard fat contents of 10 - 16 % require medium or high-viscosity CMC grades (WALOCEL™ CRT 2000 PA 07, WALOCEL™ CRT 20000 PA 07, or WALOCEL™ CRT 30000 PA at a dosage of 0.6 - 0.8 %). For low-fat fresh cheese spreads in most cases an additional gel-forming hydrocolloid (HPMC such as WALOCEL™ HM FG) is necessary to support the protein network and to provide a more solid structure than with CMC alone.

Aerated fresh cheese applications with soft stable foams are improved by adding up to 1 % WALOCEL™ CRT 2000 PA 07. This CMC grade provides good stabilization in combination with a certain increase in viscosity and thus fixes the air bubbles. An alternative solution for fresh cheese products is a mixture of CMC with a strong gel-former to produce a firmer structure.

**Benefits**

- Replacement of fat and milk protein – reduction of calories, added nutritional value (fibers)
- Protection of proteins from heat
- Stable water retention, reduced syneresis, shrinkage and dehydration during storage
- Foam stabilization in aerated products
- Improved texture and spreadability
- Enhanced mouthfeel and melt-away, good creaminess

Cheese Products
### Using CMC in cheese products

<table>
<thead>
<tr>
<th>Applications</th>
<th>WALOCEL™ CRT</th>
<th>Concentration (in the end-product)</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processed cheese (+ 5 - 10 % water)</td>
<td>20000 PA 07</td>
<td>0.5 - 0.8 %</td>
<td>Improved production due to high water content, water binding and retention, stable textures during storage, reduced syneresis and shrinkage/dehydration, partial replacement of milk &amp; fat proteins, reduction of calories, additional nutritional value, improved spreadability and texture, improved mouthfeel, melt-away and creaminess.</td>
</tr>
<tr>
<td>Fresh cheese preparations (10 - 16 % fat)</td>
<td>20000 PA</td>
<td>0.6 - 0.8 %</td>
<td></td>
</tr>
<tr>
<td>Low-fat fresh cheese spread (0.2 % fat)</td>
<td>20000 PA</td>
<td>0.5 %</td>
<td></td>
</tr>
<tr>
<td>Fat-reduced whipped fresh cheese spreads (5 - 8 % fat)</td>
<td>2000 PA 07</td>
<td>1.0 %</td>
<td></td>
</tr>
</tbody>
</table>
Grade nomenclature

<table>
<thead>
<tr>
<th>WALOCEL</th>
<th>Trademark</th>
</tr>
</thead>
<tbody>
<tr>
<td>clear+stable</td>
<td>Trademark</td>
</tr>
<tr>
<td>CRT</td>
<td>Sodium Carboxymethylcellulose</td>
</tr>
<tr>
<td>2000</td>
<td>Guide value for viscosity</td>
</tr>
<tr>
<td>P</td>
<td>Granulometry</td>
</tr>
<tr>
<td>A</td>
<td>High-purity CMC (min. 99.5 %)</td>
</tr>
<tr>
<td>07</td>
<td>Degree of substitution</td>
</tr>
</tbody>
</table>

WALOCEL™ C is manufactured from high-purity wood cellulose in compliance with GMP

Our CMC is manufactured from high-purity wood cellulose in accordance with Good Manufacturing Practice. In codes and regulations the product is listed as:

- Sodium carboxymethylcellulose
- CMC or Na-CMC
- Cellulose Gum
- E 466

Walocel™ C and clear+stable grades may be used as technological additives without any quantity restrictions (“quantum satis”) in any kind of food application.

According to the European Directive 2003/114/EC of December 22, 2003 the product may be labelled on food packages as “Na-CMC” or “Cellulose Gum”. The “E” number may be omitted.

All grades meet the requirements of:

- Food Chemical Codex
- EU Directive for E 466 in their current versions

All WALOCEL™ C and clear+stable grades for dairy applications are:

- Kosher/Halal
- gluten free
- of vegetable origin
- BSE / TSE free
- GMO free
Product Range

WAloCel™ C is manufactured from high-purity wood cellulose in compliance with GMP.
Storage

WALOCEL™ C is a stable material, but like all hydrocolloids it is hygroscopic. Once opened, the bags should be stored in well-sealed containers and kept in a cool and dry place.

Packaging

WALOCEL™ C is packed in 25 kg (net weight) paper bags with a PE barrier layer on pallets wrapped in stretch film.
<table>
<thead>
<tr>
<th>Grade *1</th>
<th>Degree of substitution</th>
<th>Particle type *2</th>
<th>Conc. (%)</th>
<th>Brookfield viscosity LVT/25°C (mPa·s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT 30 A</td>
<td>09</td>
<td>G, P</td>
<td>2</td>
<td>25 – 35</td>
</tr>
<tr>
<td>CRT 100 A</td>
<td>09</td>
<td>G, P</td>
<td>2</td>
<td>110 – 160</td>
</tr>
<tr>
<td>CRT 1000 A</td>
<td>09</td>
<td>G, P</td>
<td>2</td>
<td>550 – 800</td>
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<tr>
<td>CRT 2000 A</td>
<td>07/09</td>
<td>G, P</td>
<td>2</td>
<td>1900 – 2800</td>
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<tr>
<td>CRT 10000 A</td>
<td>09</td>
<td>G, P</td>
<td>1</td>
<td>900 – 1500</td>
</tr>
<tr>
<td>CRT 20000 A</td>
<td>07/09</td>
<td>G, P</td>
<td>1</td>
<td>1900 – 2600</td>
</tr>
<tr>
<td>CRT 30000 A</td>
<td>09</td>
<td>G, P</td>
<td>1</td>
<td>3000 – 4000</td>
</tr>
<tr>
<td>CRT 40000 A</td>
<td>09</td>
<td>G, P</td>
<td>1</td>
<td>4000 – 5000</td>
</tr>
</tbody>
</table>

*1  min. 99.5 % Na-CMC  
*2  G = Granulate; P = Powder
Dow Wolff Cellulosics stands for first-rate products plus competent and comprehensive application-related advice. Whether you need tried-and-tested standard products or whether meeting specific requirements is your prime concern – your individual requests will always be our top priority.

Thanks to their superb properties, products supplied by Dow Wolff Cellulosics help optimize the quality and performance of your end-products. Technical support provided by Dow Wolff Cellulosics experts gives you additional security.

Your threefold benefits result from

- Dow Wolff Cellulosics’ high innovative potential;
- its competence in the field of application and knowledge of the market;
- the best-buy strategy: we want you to get the best for your money.

Therefore, Dow Wolff Cellulosics makes a key contribution towards your success. Your decision in favour of Dow Wolff Cellulosics means you have selected a premium product – from one of the world’s largest suppliers of cellulose derivatives.
Please take notice of the following:

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