题目：高品质的纤维素系列辅料关键是如何选择好木浆

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报告摘要:

高品质的溶解木浆为何是高品质纤维素辅料的关键？为何桉木是高质量溶解木浆的好原材料？

Abstract:

- Pulp Mill and Forestry History
- Location of BSC and Copener
- Environmental Processes
- Forestry Operations and Raw Material
- Pulp Mill Process and Flow Sheets
- Eucalyptus fiber for MCC production

简介:

拥有超过30多年的木浆生产经验，是巴西特种纤维生产工厂的特种木浆技术支持专家。

Sateri

Sateri Holdings Limited

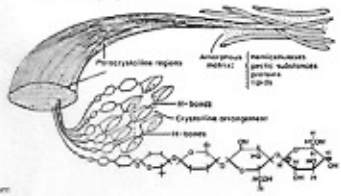
DISSOLVING WOOD PULP USED INTO MCC PRODUCTION

What is Microcrystalline Cellulose?(1/2)

- MCC is the crystalline cellulose remaining after removal of amorphous cellulose through hydrolysis of chemical cellulose pulp with (typically) Hydrochloric Acid.The major uses of this material include pharmaceutical tableting and food stabilization.
- Two major types are produced:
- **Powdered MCC.** (Spray dried – aggregated – porous plastic and sponge like product). The primary function is to serve as a binder or disintegrant for tablets, as a flow aid for cheeses, as a carrier for flavours and as a fibre.
- **Colloidal cellulose.** Major functions are as an emulsion stabilizer, a thixotropic thickener, a foam stabilizer, an ice cream controller, a suspension agent and a provider of cling.

What is Microcrystalline Cellulose?(2/2)

- In Chemical Cellulose Pulp, linear cellulose polymers are bundled together to form a micro fibril. Micro fibrils exhibit a high degree of internal bonding resulting in a three dimensional crystalline structure. However within the micro fibril there are so called dislocations with weaker internal bonding and disruptured structure. These are called amorphous areas known as Para crystalline regions. The crystalline regions are isolated as microcrystalline cellulose after removal of the amorphous cellulose through acid hydrolysis.
- Microcrystalline cellulose is white, odorless, tasteless and free of organic and inorganic contaminants. It is insoluble in water, dilute acids, most organic solvents and practically insoluble in sodium hydroxide.
- Microcrystalline cellulose is universally used in the pharmaceutical and nutraceutical industries as well as in colloidal applications for food grades.
- MCC revolutionized tableting because of its unique compressibility and carrying capacity. It exhibits excellent properties as an excipient for solid dosage forms. It compacts well under minimum pressures, has high binding capability and creates tablets that are extremely hard, stable, yet disintegrate rapidly. These properties make MCC valuable as a filler and binder for formulations prepared by direct compression, although it is also used in wet or dry granulation. In colloidal grades, MCC exhibits specialized rheological characteristics which impart unique functional properties.

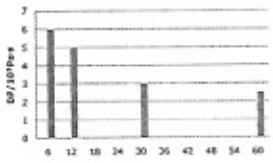


MCC Application of colloidal grades(1/2)

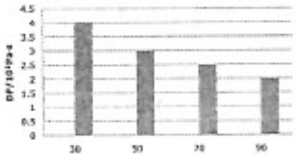
- **Food applications (colloidal grades)**

In most food systems MCC is used as part of an overall fat mimetic system which often includes soluble hydrocolloids, starch, fat flavours, and anti-microbial agents. The quantity of MCC required depends on the amount and type of fat being replaced. Usage levels are typically 0, 4 to 3%. As mentioned before Microcrystalline Cellulose exhibits specialized rheological characteristics which impart unique functional properties. When dispersed in water with sufficient shear, the MCC particles form a microscopic 3 D network of crystals. Soluble hydrocolloids are co-processed with MCC. The co-processed soluble hydrocolloids facilitate the formation of this network by acting as water swelling capillaries between the crystals, forcing them to open during hydration. This network is then stabilized by hydrogen bonding between the polar groups on the surface of the cellulose. The soluble hydrocolloids also function to consolidate the network through hydrogen bonding to the MCC.

Shear rate correlation with MCC



Temperature affect with MCC

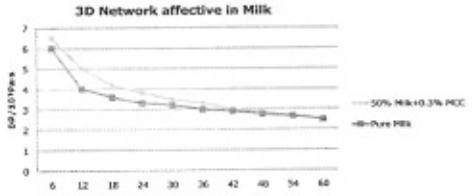


MCC Application of colloidal grades(2/2)

This network imparts a unique rheology and structures water in a completely different manner from soluble gums and thickeners. The forces holding the network together are shear sensitive and break down readily. When the shear is removed, the 3 D network quickly reforms giving MCC dispersions marked thixotropic properties. This thixotropic network of insoluble crystals is physically and functionally similar to the insoluble network of dispersed oil droplets in oil in water emulsion and is the key to the unique functionality of colloidal MCC in fat replacement. Within food systems, these particles contribute a fat like consistency, a creamy mouth feel, body and opacity. With MCC's it is possible to mimic some or all of the mouth feel ,opacity, consistency, and body contributed by fat in a vast array of food products.

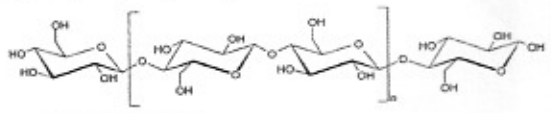
Thixotropic – gels that readily break down with shear. When the shear is removed, the gel will reform over time with minimal loss in viscosity.

3D Network affective in Milk



MCC Application of Powdered grades(1/2)

- Powdered MCC is commonly used in foods and pharmaceuticals as a high quality inert fibre source and a non calorie bulking agent. Additionally, the porous and free flowing nature of these products makes them ideal as carriers of liquid materials such as essential oils. They are also used as anti-caking agents in grated cheese and reduced fat/calorie products low in moisture. Low moisture applications require high levels of non or low calorie bulking agents to achieve a sufficient calorie / fat reduction. (Sugar syrups)
- When cellulose pulp are dispersed in 17.5% NaOH solution,where the non-solved parts of it can be removed, a white residue of pure Alpha-cellulose after washing and pulverization is called cellulose powder,having lower degree of polymerization.



3 Molecular structure of cellulose

MCC Application of Powdered grades(2/2)

- **Pharmaceutical and Nutraceutical products.**

  The primary function of MCC is to serve as a binder / diluent in oral tablet and capsule formulations. MCC also has some lubricant and disintegrant properties that is useful in tableting. Both wet and dry granulation, and direct compression processes are used.The purpose of granulation is to improve flow of the mixture and enhance compressibility.

- **Direct compression.**

  As mentioned earlier, MCC revolutionized tableting because of its unique compressibility and carrying capacity. It exhibits excellent properties as an excipient for solid dosage forms. It compacts well under minimum pressures, has high binding capability and creates tablets that are extremely hard , stable, yet disintegrate rapidly. These properties make MCC valuable as a filler and binder for formulations prepared by direct compression. Other key advantages include low friability, inherent lubricity, and the highest dilution potential of all binders.

Wet and Dry granulation(1/2)

- The purpose of granulation is to improve flow of a mixture and to enhance compressibility. Granulation is defined as a process which causes the powdered particles to adhere permanently each other to form large particles called granules. The compression of powders involves breaking of a crystal lattice and the re-bonding of lattices to yield a unit structure. Binders provide the bridging gap between and among the ingredients that would rather stay apart.

Wet and Dry granulation(2/2)

- **Wet granulation.**

  This is the most widely used method of granulation in the pharmaceutical industry. In wet granulations at least one additional ingredient has been required to be used as a binder (ie corn starch, ethyl cellulose) to produce a ready to use excipient and requiring only one drying.

  MCC is advantageously used (5 – 10%) for wet granulation. The wicking action of MCC promotes rapid wet massing of the powder mix. Its ability to retain water makes the wet mass less sensitive to over wetting due to excess granulating fluid.

  The aggregation of particles is obtained by using a liquid phase – a solution, suspension or slurry of a binding agent. The binder is added to a homogenous powdered mixture containing the active ingredient. The binder solution is homogeneously distributed in the powdered mixture by kneading the lumps of the liquid / solid mixture. The solvent evaporates during the drying step.

  Products obtained by wet granulation are spherical/cylindrical and free flowing (with a previously defined particle size – 0,1 – 2 mm). These products can be used as a dosage form or as intermediates in the production of tablets and capsules.

Pulp Requirement(1/2)

- **Pulp Purity.** Reference to cleanliness and contamination. The pulp must be as free as possible of dirt, bark, shives or other material that can deposit on or within the pulp sheet from the pulp processing environment.

  Purity in terms of cellulose content determines functionality of the final MCC product. That is, higher S18 pulps generally have higher LODP's which will be required for pharmaceutical tableting. High alpha grades with low S18 give low LODP (≈ 160 DP) and are generally more suitable for colloidal MCC grades.

  In all uses, resin is a problematic contaminant. On acid hydrolysis the resins can produce black specs that will ultimately be included in the final MCC product. Resin extracts can also deposit and coat equipment used in the MCC process which would require cleaning and plant down time.

  Natural resin extracts need to be below 0, 05% on pulp and the best pulps tend to have levels below 0, 02%.

- **Pulp DP** has no direct impact on the final MCC grade.

Pulp Requirement(2/2)

- **Brightness.** High brightness levels are typical of dissolving pulp grades either because they are pure or the impurities have been bleached. A consistent brightness level is an indicator of stable processing conditions.

  As long as the pulp can be successfully hydrolysed and all contaminants removed, leaving pure crystalline cellulose, then the colour is determined by the colour of cellulose which to the eye is 'pure white'. Brightness level is more an indicator of pulp process changes impacting on non-cellulosic constituent levels.

- **Dirt count** needs to be as low as possible. A level of 0, 5 mm2/m2 is suitable.

- **Water solubles.** Pulp needs to be well washed to minimize water soluble material that end up in the final MCC products.

In summary, high alpha pulps will be suited for food grade colloidal applications and lower alpha pulps for pharmaceutical tablets and nutraceuticals.

MCC for pharmaceutical grades will tend to require pulps with LODP above 210 whereas colloidal grades below 160 DP.

Eucalyptus Fiber for MCC production

- Eucalyptus as raw material for DP – Dissolving Pulp
- Fiber morphology
- Chemical characteristics
- BSC pulp for MCC production

Eucalyptus as raw material

✓ BSC uses 100 % of *Eucalyptus urograndis* to produce High Alpha Grade Specialty Cellulose

- Eucalyptus grows in 5 to 6 years
- Planted in poor soil areas: no competition with food agriculture areas
- Does not require special water devices as irrigation

✓ Brazil is the leader in Eucalyptus utilization:

- Forest Plantation & Development with best field management practices
- Pulp production with kraft process

Fiber morphology

Fiber source	Length mm	Width μ	Wall Thickness μ
Scandinavia Spruce	~2	40	7
CLP	2-6	16-24	5-10
Southern Pine	3.5-4	35-45	5-11
Eucalyptus Urograndis	0.6-0.8	15-18	3

Eucalyptus fibers have special uniqueness:

- Short fiber length and thin walled
- Low grain size (Weight per length)
- Highest number of fibers per gram
- High surface area

Pulp Characteristics

Specification		Products used for MCC production: Crystal	Crystal EX	Crystal DB	Crystal PL
Density	g/m³	≥ 0.70 ≤ 0.58	≥ 0.70	≤ 0.58	≥ 0.70
Alpha	%	≥ 94.5	≥ 94.8	≥ 96.7	≥ 97.0
S18	%	≤ 4.0	≤ 3.7	≤ 2.5	≤ 2.0
S10	%	≤ 7.0	≤ 6.8	≤ 4.0	≤ 4.0
Brightness	%ISO	≥ 90.0	≥ 91.0	≥ 90.0	≥ 92.0
Viscosity	ml/g	450-550	500-600	600-750	600-750
DCM	%	≤ 0.10	≤ 0.07	≤ 0.10	≤ 0.07
Ash	%	≤ 0.10	≤ 0.10	≤ 0.10	≤ 0.10
Calcium	ppm Ca	≤ 50	≤ 50	≤ 50	≤ 50
Iron	ppm Fe	≤ 8	≤ 8	≤ 5	≤ 4
Silica	ppm SiO_2	≤ 50	≤ 50	≤ 50	≤ 50

Very uniform and constant product (100% from the same wood specie + very well controlled process)

BSC wood pulp for MCC production

- High alpha content: 95 to 98 %
  - products with different crystalinity degree
  - can give different LODP (according customer application)
  - high alpha more suitable to low LODP requirements
  - typical LODP is 170 to 190
  - good compaction characteristics
- Low S18 (Solubility in NaOH 18%)
  - means low pentosans content that gives a stable and good final quality
  - less weight loss
  - typical dissolved material is 5 to 6%
- Very low ash content (low inorganic contaminants)
  - low inorganic contaminants with pulp

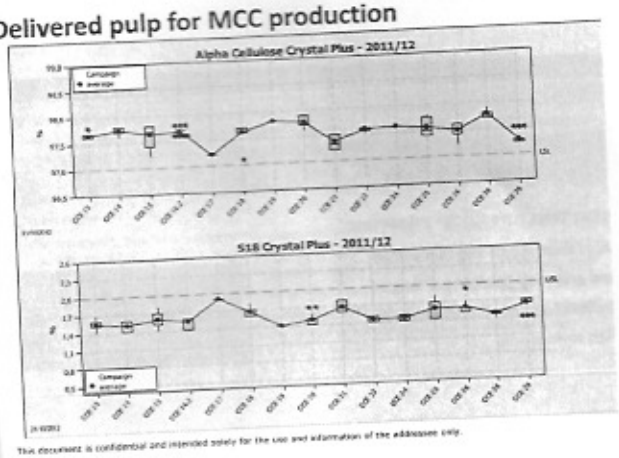
BSC wood pulp for MCC production

- Very clean pulp and Low resin content
  - very low dirt content
  - no formation of black points during processing/drying
  - low DCM means less requirement for equipment cleaning
- Sheet density: high or low
  - can be designed according customer requirements
  - recommended to process the pulp sheet in chips avoiding fines formation through shredders and hammer mills
- Very good flake formation (feeding line)
  - for some installations it is used a pulp sheet press (metal cylinders) in the feeding line before the mechanical treatment
  - this improves the flake quality and its bulk density
  - the short fiber produces better formatted flakes

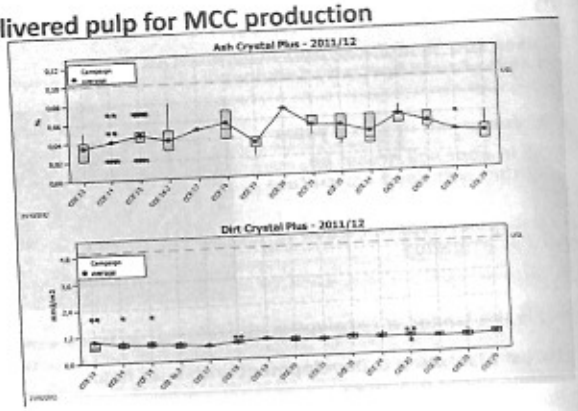
BSC wood pulp for MCC production

- Hydrolysis behavior
  - degradation rate (reactivity) is very high
  - due to the *Eucalyptus* fiber characteristics there is a more intimate contact of the acid with the cellulose
  - has potential to require lower reaction temperature and lower acid concentration (acid / pulp ratio can be optimized)
  - recommended starting the utilization keeping the same process conditions and adjusting according results/process behavior
- Drying
  - very good performance during drying (spray dry tower)
  - *Eucalyptus* short fiber morphology helps the drying water removal mechanism
- Our *Eucalyptus* pulp is being used for MCC production since 2004
  - it can be used alone or in mixture with other pulps
  - the blend ratio can be till 40 to 50%, although it is dependent of each installation: process technology – final products

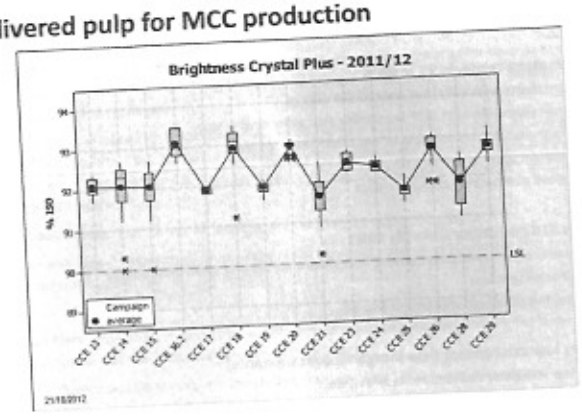
Delivered pulp for MCC production



Delivered pulp for MCC production



Delivered pulp for MCC production



Thank you!

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