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Method for producing microfibrillated cellulose(MFC), wherein the method comprising the steps of: Pre-treating of chemical pulp, such that, the pulp reaches a Schopper-Riegler (SR) value above 50, and refining the pulp, at a consistency of 3-6%, in a refiner with refiner blades, wherein the height of the refiner blades is in the range 2-3mm.

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(54) Title: METHOD AND APPARATUS FOR PRODUCING MICROFIBRILLATED CELLULOSE FIBER

(57) Abstract: Method for producing microfibrillated cellulose(MFC), wherein the method comprising the steps of: Pre-treating of chemical pulp, such that, the pulp reaches a Schopper-Riegler (SR) value above 50, and refining the pulp, at a consistency of 3-6%, in a refiner with refiner blades, wherein the height of the refiner blades is in the range 2-3mm.



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**METHOD AND APPARATUS FOR PRODUCING MICROFIBRILLATED
CELLULOSE FIBER**

5 The present invention relates to a method and apparatus
for producing microfibrillated cellulose fibres.

In the following, the concept "chemical pulp" will be
frequently used in the application. Chemical pulp is a
10 lignocellulosic fibrous material prepared by chemically
separating cellulose fibres from a fibre-containing
material. Chemical pulp is produced by combining fibre-
containing material and chemicals in large vessels known
as digesters where heat and the chemicals break down the
15 lignin, which binds the cellulose fibres together,
without seriously degrading of the cellulose fibres.

The concept "fibre-containing material" is later to be
understood as a wide concept comprising wood chips, grass
20 and other fibre-containing materials originating from the
vegetable kingdom, which have been crushed into pieces of
appropriate sizes so they can be fed into the device.

The concept "microfibrillated cellulose" (MFC) is also
25 known as nanocellulose. It is a material typically made
from wood cellulose fibres, both from hardwood or
softwood fibres. It can also be made from microbial
sources, agricultural fibres such as wheat straw pulp,
bagasse, bamboo or other non-wood fibre sources. In
30 microfibrillated cellulose the individual microfibrils
have been partly or totally detached from each other. A
microfibrillated cellulose fibre is normally very thin

(~20 nm) and the length is often between 100 nm to 10 μm . However, the microfibrils may also be longer, for example between 10-200 μm , but lengths even 2000 μm can be found due to wide length distribution. Microfibrils that are
5 separated and located in a water phase of slurry are included in the definition MFC.

“Refining” of chemical pulp in a refiner is the mechanical treatment and modification of fibres so that
10 they can be formed into paper or board of desired properties.

It is known to produce MFC with multiple passes of chemical pulp through a refiner, see for example
15 WO2012089930A1 and US7381294B2. Every pass leads to an energy loss, so called no-load energy, measured so that energy needed when water runs through the refiner. This energy loss can be very high, typically about 20-40% of the total energy. The more passes the pulp runs through
20 the refiner, the more difficult it will be to load the refiner (as pulp does not stay between the refiner blades), but the no-load energy stays the same, this leads to that more amount of the total energy is lost (typically turns into heat).

25

Thus, there is a strong need to reduce the amount of needed passes through the refiners in order to reduce the loss of energy. Moreover, there is a need to have more homogenous refining of high Schopper-Riegler (SR)
30 chemical pulp.

A standard height of the refiner blades when refining fibres is in the range 6-10 mm. This is due to the

runnability issues and that the pressure difference must be maintained. Wear of the refiner blades is another issue that is crucial so therefore, a certain height of the blades is needed.

5

The method according to the invention is characterized in that the method comprising the steps of:

- pre-treating of chemical pulp, such that, the pulp reaches a Schopper-Riegler (SR) value above 50, and
- 10 - refining the pulp, at a consistency of 3-6%, in a refiner with refiner blades, wherein the height of the refiner blades is in the range 2-3 mm.

The apparatus according to the invention is characterized
15 in that the apparatus is a refiner for refining chemical pulp with refiner blades, wherein the height of the refiner blades are in the range of 2-3 mm and wherein the cutting edge length (CEL) value of the refiner is higher than 70 km/rev.

20

Such low heights as 2-3 mm of refiner blades is normally not used due to the flow through the refiner is reduced and blocking of the blades will occur.

25 In accordance with the invention the pulp is highly refined and have a SR value above 50, preferably above 60. The blocking of the refiner blades is prevented due to the lower fibre length and reduced flocking and dewatering tendency of the pulp.

30

If using conventional refiner blades, with a longer height, for a pulp having a SR value above 50, it would not be possible to load the refiner. This is due to less

flocking of the pulp and the pulp will not stay between the refiner blades and mechanical contact will occur if the refiner is loaded too much.

5 However, with the low height of the refiner blades, in accordance with the invention, it is possible to keep pulp between the refiner blades and thus increase the loading of the refiner. Thus, with only one refiner it is possible to put more energy into fibres, and reduce the
10 amount refiners. Hence, instead of using 2-3 refiners, the invention makes it possible to only use one refiner.

When using only one refiner, the no load energy (i.e. energy taken by the refiner without the pulp, no load is
15 measured by running refiner with water only) per produce ton of fibres is much less than when using several refiners.

Normally one must refine the pulp several times (with the
20 same blades) or in several steps (different type of blades) to produce MFC. This require high energy, high investments, and result in an uneven MFC quality.

However, by starting the refining from a pulp with a high
25 SR value as 50, preferably 60, the use of the specific blade will considerably enhance the pulp quality.

Example

In one embodiment of the invention, the method comprising
30 the steps of:

Pre-treating of chemical pulp, such that, the pulp reaches a Schopper-Riegler (SR) value above 50. This may be made by pre-refining of the chemical pulp.

The pulp is refined, at a consistency of 3-6%, in a refiner with refiner blades, wherein the height of the refiner blades is in the range 2-3 mm.

5

The cutting edge length (CEL) of the refiner during refining is preferably higher than 70 km/rev.

The surface edge load (SEL) during refining is preferably
10 lower than 0.5 and more preferred lower than 0.3.

The refining is performed in an alkaline environment where the pH is higher than 8, preferably higher than 9. The alkaline environment and the short refiner blades
15 facilitate the refined fibres to slip through the refiner.

The temperature during refining is higher than 40°C, preferably higher than 50°C. Conventionally, it is
20 difficult to keep these high temperatures, but thanks to the low height of the refiner blades this matter is facilitated. The low height also gives a more even temperature during refining.

25 The rotation speed of the refiner blades during rotating is about 1000-1600 rpm.

The refiner is preferably a conical refiner.

30 The invention (method and apparatus) has several benefits in comparison to prior art, such as:

- Require less steps of refining.
- Less fractions of unrefined fibres.

- Require less investment costs (don't require different blades).
- Possibility to have a higher edge load.

5 In the foregoing, the invention has been described on the basis of some embodiments. It is appreciated, however, that other embodiments and variants are possible within the scope of the following claims.

CLAIMS:

1. Method for producing microfibrillated cellulose (MFC),
wherein the method comprising the steps of:
- 5 - pre-treating of chemical pulp, such that, the pulp reaches a Schopper-Riegler (SR) value above 50, and
- refining the pulp, at a consistency of 3-6%, in a refiner with refiner blades, wherein the height of the refiner blades is in the range 2-3 mm.
- 10
2. Method according to claim 1, wherein the refining step further comprises that the cutting edge length (CEL) during refining is higher than 70 km/rev.
- 15
3. Method according to claim 1 or 2, wherein the surface edge load (SEL) during refining is lower than 0.5 J/m.
4. Method according to claim 1 or 2, wherein the surface edge load (SEL) during refining is lower than 0.3 J/m.
- 20
5. Method according to any one of claims 1-4, wherein the pH during refining is higher than 8.
6. Method according to any one of claims 1-4, wherein the pH
- 25 during refining is higher than 9.
7. Method according to any one of claims 1-6, wherein the temperature during the refining step is higher than 40°C.
- 30
8. Method according to any one of claims 1-6, wherein the temperature during the refining step is higher than 50°C.

9. Method according to any one of claims 1-8, wherein the refining step further comprises that the refiner blades rotating with a rotation speed of 1000-1600 rpm.

5 10. Method according to any one of claims 1-9, wherein the pre-treating step comprising a pre-refining of the chemical pulp.

11. Apparatus for producing microfibrillated cellulose (MFC) from chemical pulp, wherein the apparatus is a refiner for
10 refining chemical pulp with refiner blades, wherein the height of the refiner blades is in the range of 2-3 mm and wherein the cutting edge length (CEL) value of the refiner is higher than 70 km/rev.

15 12. Apparatus according to claim 11, wherein the refiner is a conical refiner.