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(71) Applicant: **Voith Paper Patent GmbH**

89522 Heidenheim (DE)

(72) Inventor: **Dölle, Klaus, Dr.**

88353, Kisslegg (DE)

(54) **Method for the production of a fiber web**

(57) A method for the production of a fiber web from a fiber stock suspension including a filler, including the steps of: selecting at least one size of at least one filler particles for a predetermined color of the fiber web, including at least one filler particles in the filler, adding at

least one filler including at least one filler particles of at least one size in the fiber stock suspension and producing the fiber web in the predetermined color.

EP 1 518 961 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the invention.

[0001] The present invention relates to a method for the production of a fiber web, specifically a paper or cardboard web, from a fiber stock suspension.

2. Description of the related art.

[0002] The current trend is to produce paper having brightness values that are as high as possible. These brightness values may be achieved by introducing fillers such as calcium carbonate, or ground calcium carbonate into the fiber stock suspension.

[0003] The loading with an additive, i.e. a filler, may occur for example through a chemical precipitation reaction, that is specifically through a so-called "fiber loading" process, such as described in the prior art documentation U.S. Patent No. 5,223,090 and U.S. Patent No. 6,355,138, among others. During such a "fiber loading" process at least one additive, specifically a filler, is deposited on the moistened fiber surfaces of the fiber material. The fibers may, for example, be loaded with calcium carbonate. To this end, calcium oxide and/or calcium hydroxide are added to the moist disintegrated fiber material in such a manner, whereby at least a portion of these additives associates with the water that is contained in the fiber material. The fiber material treated in this manner is subsequently supplied with carbon dioxide.

[0004] What is needed in the art is a method for loading a fiber web with an additive to improve brightness and that would provide as simple and as reliable a method as possible for the production of fiber webs in various colors.

SUMMARY OF THE INVENTION

[0005] The present invention provides a method for the production of a fiber web, specifically a paper or cardboard web, from a fiber stock suspension containing a filler, whereby the size of the filler particles is selected with the particular objective of producing a fiber web of a predetermined color.

[0006] The present invention comprises, in one form thereof, a method for the production of a fiber web from a fiber stock suspension including a filler, including the steps of: selecting at least one size of at least one filler particles for a predetermined color of the fiber web, including at least one filler particles in the filler, adding at least one filler including at least one filler particles of at least one size in the fiber stock suspension and producing the fiber web in the predetermined color.

[0007] An advantage of the present invention is a simple and reliable method for the production of fiber webs

in various colors.

[0008] Another advantage is the production of fiber webs in various colors with improved brightness.

[0009] Yet another advantage is the fact that the dispersion and reflection of light is dependent upon the respective particle size.

DETAILED DESCRIPTION OF THE INVENTION

[0010] According to a preferred practical arrangement of the method according to the present invention, filler particles of one and the same size are utilized in order to produce the color of the fiber web. In this instance the color produced by the relevant particle size constitutes the actual color of the fiber web that is visible from the surface.

[0011] According to an advantageous alternative arrangement, filler particles of varying sizes are utilized whereby the different particle sizes are selected so that the color of the fiber web results from the different colors produced by the different particle sizes. The visible exterior color of the fiber web therefore, results from two or more primary colors produced by the respective particle sizes. Specifically three different particle sizes may be used in this process, and the different particle sizes selected so that three primary colors are produced from which the color of the fiber web results. The utilized volume of fillers of a specific particle size is controlled and/or adjusted to advantage. Specifically, the ratio of the utilized filler volumes of varying particle sizes can also be controlled and/or adjusted.

[0012] According to a functional practical arrangement of the method in accordance with the present invention, the throughput of at least one partial suspension stream containing filler of a certain particle size is controlled and/or adjusted. Specifically, the relationship of the throughputs of two or more partial suspension streams containing fillers of varying particle sizes can also be controlled and/or adjusted.

[0013] According to an effective arrangement of the method in accordance with the present invention, several fiber webs containing fillers of varying particle sizes are produced, and the varying particle sizes selected with the objective that the color of the finished fiber web will be a result of the different colors produced by the varying particle sizes. Specifically, several headboxes may be used whose partial suspension streams contain filler of varying particle sizes. The headbox throughputs and/or the filler content of the partial suspension streams can be controlled and/or adjusted.

[0014] Advantageously three headboxes are utilized in order to produce three primary colors through three different filler particle sizes, resulting in the color of the fiber web.

[0015] In order to produce the filler particles, a chemical precipitation reaction is effectively triggered and/or a refining process carried out. Basically however, any other desired manufacturing process is also feasible.

The filler can consist specifically of one or several of the following materials: precipitator, synthetic material, calcium carbonate, talc, TiO_2 , silica and/or similar materials.

[0016] According to a preferred practical arrangement of the method in accordance to the present invention, the fiber suspension is loaded with filler through a chemical precipitation reaction, whereby especially crystalline precipitator particles are produced. The precipitator may for example be calcium carbonate.

[0017] It is also particularly advantageous if calcium oxide and/or calcium hydroxide is added to the fiber stock suspension for the purpose of loading the fibers, and if the precipitation is triggered by supplying carbon dioxide to the fiber suspension.

[0018] When loading the fibers with filler, calcium carbonate (CaCO_3) can for example be deposited at the moistened fiber surfaces by adding calcium oxide (CaO) and/or calcium hydroxide (Ca(OH)_2) to the moist fiber material, whereby at least a portion of this can associate with the water of the fiber volume. Carbon dioxide (CO_2) can then be introduced to the treated fiber material.

[0019] The term "moistened fiber surfaces" may encompass all moistened surfaces of the individual fibers. This specifically also encompasses the instance where the fibers are loaded with calcium carbonate or any other desired precipitator on their outer surface as well as in their interior (lumen).

[0020] Accordingly, the fibers may for example be loaded with the filler calcium carbonate, whereby the deposit onto the moistened fiber surfaces occurs through a so-called "fiber loadingTM" process, as described in the prior art documents U.S. Patent No. 5,223,090 and U.S. Patent No. 6,355,138. In this "fiber loadingTM" process the carbon dioxide reacts, for example, with the calcium hydroxide to water and calcium carbonate. The calcium hydroxide may be introduced to the fiber stock suspension in liquid or in dry form.

[0021] Specifically a refining process can produce the appropriate particle size.

[0022] A preferred practical arrangement of the method according to the present invention distinguishes itself in that the fiber stock suspension is loaded with filler through a chemical reaction and in that the fibers that are loaded with filler are refined in order to produce an appropriate filler particle size.

[0023] In certain instances it may be advantageous if a chemical color is used additionally as a brightener. Production of paper in different colors is therefore possible for example, by utilizing particles whose size is selected so that for the production of a certain color in the finished paper, a respective color of the visible light is reflected.

[0024] The particles that are present in the finished product may for example be produced by a precipitation reaction, by refining and/or by another production process. The utilized material may, for example, be a precipitator or a synthetic material, calcium carbonate, talc,

TiO_2 , silica and/or a similar material.

[0025] The particle size is fundamental to achieving optimum opacity as well as the desired color. A high opacity or brightness is achieved when the color spectrum of the visible light is well dispersed. If the entire color spectrum is absorbed, the resulting color will be black. If the filler particle size is below a value of specifically 0.2 to 0.5 μm , the tendency is toward achieving a higher transparency and a higher gloss.

[0026] In order to obtain colored paper, the particle size of the filler must be in a range in which only one color of the visible light is reflected. The paper then possesses a resulting color that is complimentary to the absorbed color. If for example, a filler particle absorbs the color blue, the resulting color will be yellow. If a filler particle is produced which absorbs only one color, then the paper will be in the complimentary color.

[0027] If the paper contains two filler particles, or more precisely two filler types that differ in their particle size, where the one particle or the one filler type absorbs for example the color blue and the other one absorbs the color yellow, then the resulting paper color will be green.

[0028] Obviously, any other examples of the method according to the invention would also be feasible.

[0029] Viewed physically, color is an optical phenomenon that captures a certain frequency range of the visible light. Light is known to be a form of electromagnetic radiation that transmits at the velocity of light. Color is a subjective immaterial sensation that occurs when light enters the eyes.

[0030] The visible spectrum of light has a wavelength of 400 to 800 m, whereby certain color impressions occur at certain wavelength ranges, as indicated in the table below:

Wave length range	Color impression
800 - 605	red
605 - 595	orange
595 - 580	yellow
580 - 560	yellow-green
560 - 500	green
500 - 490	bluish-green
490 - 480	green-blue
480 - 435	blue
435 - 400	violet

[0031] White light is not a color in the physical sense. It does however, show a mixture of all above referenced colors. If one color of the visible light is filtered out, the complimentary color remains as indicated in the table below:

Filtered out color	Complimentary color
Blue	Yellow
Red	Cyan

(continued)

Filtered out color	Complimentary color
Green	Magenta

[0032] Basically, a color can also be produced through a combination of various colors, as indicated in the following examples:

Resulting Color	Original colors
White	= Red + Green + Blue
Yellow	= Red + Green
Magenta	= Red + Blue
Cyan	= Green + Blue

[0033] Basically, color can originate in various ways. Chemical colors for example, find their origin in colored substances, atoms and especially in molecules that selectively absorb the sources of light, whereby the color of the atoms or molecules is complementary to the filtered out light. Structural colors result through refraction, reflection, dispersion and interference.

[0034] For the production of colors according to the present invention through correlative particle sizes, and particularly for utilization of the so-called "fiber loadingTM" process the dispersion and reflection is of particular interest. In contrast, refraction is used primarily in optical devices. Interference or superposition of waves is also excluded in this instance.

[0035] Light is dispersed on very small particles such as for example dust, in other words, it is reflected in all directions. The dispersion effect depends greatly on the wavelength. Higher frequencies with shorter wavelengths therefore, are dispersed more strongly. Blue light for example, is dispersed approximately ten times more strongly than red light.

[0036] In the case of a medium consisting of extremely small particles, the blue light is dispersed or filtered out first, and then the yellow light. A white light beam changes its color from white to yellow and then to red.

[0037] In the application of, for example, a paper containing fillers, white paper is created when the filler particles reflect the entire spectrum colors, resulting in white light. White paper therefore is created if the filler particles are of appropriately different sizes. Transparent paper is created when the light can pass unimpeded through the paper, that is, if light is possibly reflected but, however, no light sources of certain size are filtered out. If a filler particle is produced that filters out a certain wavelength of the visible light, then the paper will appear in the complimentary color. If for example, blue is filtered out, then the paper will appear in the color yellow.

[0038] If for example different layers are contained in a certain paper type, that respectively filter out a certain wavelength of light, and that are additively mixed, then basically, any desired paper color can be selected. In

one example of the method according to the present invention, the coating processes that were hitherto used for coloring of the paper are superfluous. A pre-condition for this is that the filler pigments only filter out the respective color, irrespective of whether they were produced by the so-called "fiber loadingTM" process or by another manufacturing process. This may signify for example, that the respective headbox must be controlled and/or adjusted to an optimum with regard to its throughput and with regard to the filler content. This signifies that, for example, three headboxes with fillers of different particle sizes containing a respective primary color may be utilized, in order to cover the entire color range.

[0039] A possible gray cast in the produced paper colors may be avoided by additionally using chemical colors in lower volumes as brightening agents.

[0040] Basically, other desired arrangements of the method according to the invention are also feasible.

[0041] While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

Claims

1. A method for the production of a fiber web from a fiber stock suspension including a filler, comprising the steps of:
 - selecting at least one size of at least one filler particles for a predetermined color of the fiber web;
 - including at least one said filler particles in the filler;
 - adding at least one filler including at least one said filler particles of at least one said size in the fiber stock suspension; and
 - producing the fiber web in said predetermined color.
2. The method of claim 1, wherein said method is carried out using a single said size of said filler particles.
3. The method of claim 1, wherein said method is carried out using a plurality of said sizes of said filler particles, said plurality of said sizes produces a plurality of colors, said predetermined color of the fiber web resulting from said plurality of colors.
4. The method of claim 3, wherein said method is car-

ried out using three different said sizes of said filler particles to produce three primary colors which results in said predetermined color of the fiber web.

5. The method of claim 1, wherein said method is carried out using at least one volume of said filler particles, each distinct said volume corresponding to a distinct said size, at least one said volume is at least one of controlled and adjusted.

6. The method of claim 5, wherein said method is carried out using at least one ratio of at least one said volumes, said ratio is at least one of controlled and adjusted.

7. The method of claim 1, wherein said method is carried out using the fiber stock suspension including at least one partial suspension stream, each distinct said partial suspension stream corresponding to a distinct said size of said filler particles and a throughput, at least one said throughput is at least one of controlled and adjusted.

8. The method of claim 7, wherein said method is carried out using at least one ratio of a plurality of said throughputs, said ratio is at least one of controlled and adjusted.

9. The method of claim 7, wherein said method is carried out using a plurality of headboxes, each said headbox including at least one said partial suspension stream and a headbox throughput, at least one said partial suspension stream including a content of said filler of varying said sizes of said filler particles, at least one of said headbox throughput and said content are at least one of controlled and adjusted.

10. The method of claim 9, wherein said method is carried out using three said headboxes to produce three primary colors through three distinct said sizes of said filler particles which results in said predetermined color of the fiber web.

11. The method of claim 1, wherein said method is carried out producing a finished fiber web including a plurality of the fiber webs, each of the fiber webs including said fillers of varying said sizes of said filler particles, each said size of said filler particles associated with a different color, said sizes selected to produce said finished fiber web in said predetermined color, resulting from said different colors produced by said sizes of said filler particles.

12. The method of claim 1, further including the step of producing at least one said filler particles by at least one of triggering a chemical precipitation reaction and a refining process, said producing at least one

said filler particles step is prior to said including step.

13. The method of claim 1, wherein said method is carried out with said filler including at least one of precipitator, synthetic material, calcium carbonate, talc, TiO_2 , silica and similar materials.

14. The method of claim 1, wherein said method is carried out by loading the fiber suspension with said filler through a chemical precipitation reaction.

15. The method of claim 14, wherein said chemical precipitation reaction produces a crystalline precipitator particles.

16. The method of claim 15, wherein said precipitator is calcium carbonate.

17. The method of claim 16, further including the steps of adding at least one of calcium oxide and calcium hydroxide to the fiber stock suspension, the fiber stock suspension including fibers, the fibers are loaded by said adding step; and supplying carbon dioxide to the fiber suspension thereby triggering said chemical precipitation reaction.

18. The method of claim 1, further including a refining process step to produce a predetermined said size of said filler particles.

19. The method of claim 1, further including the steps of loading the fiber stock suspension with said filler through a chemical reaction, the fiber stock suspension including fibers which are loaded with said filler; and refining the fibers thereby producing a predetermined said size of said filler particles.

20. The method of claim 1, wherein said method is carried out using a chemical color as a brightener.



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EUROPEAN SEARCH REPORT

Application Number
EP 03 10 3521

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Place of search MUNICH		Date of completion of the search 17 March 2004	Examiner Naeslund, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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