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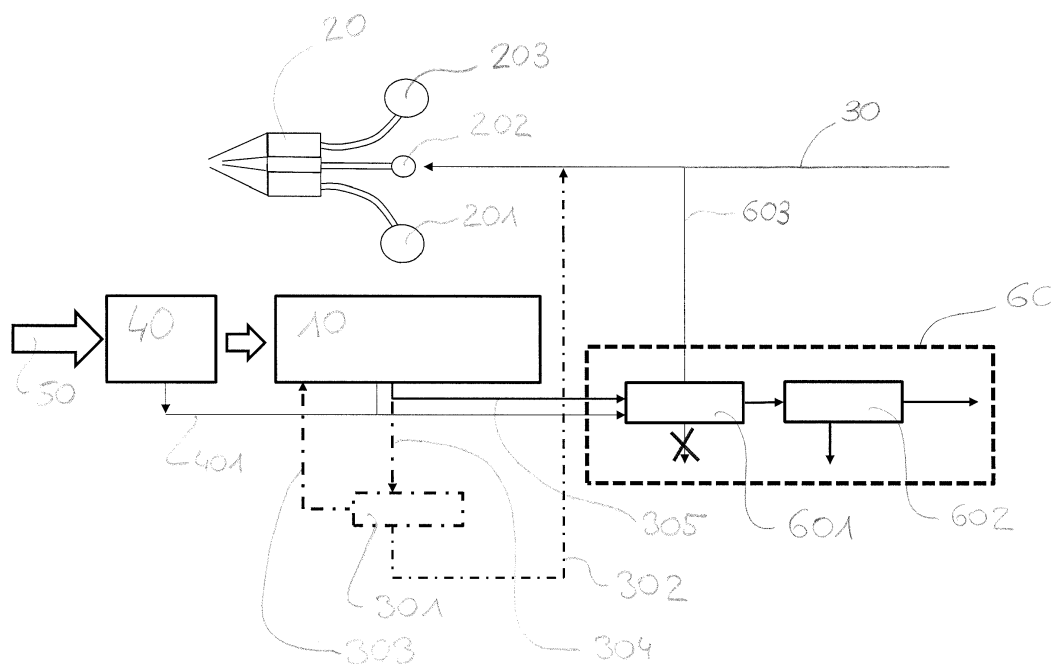
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(54) **Waste sludge recycling apparatus and method for recycling of waste sludge**

(57) The present invention relates to a waste sludge recycling apparatus for a multilayer headbox being capable of supplying liquids onto a wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds to form corresponding layers of the multilayer fiber web in a forming section of a fiber web making machine, comprising a waste sludge recirculation means configured to be connected to at least one of the manifolds of the multilayer headbox for supplying waste sludge to be recycled to the at least one of the manifolds.

Further, a waste sludge recycling method for forming a multilayer fiber web is provided, which comprises the steps of supplying liquids in a layered manner onto a wire of a forming section of a fiber web making machine via a multilayer headbox including a plurality of manifolds to form corresponding layers of the multilayer fiber web, and recirculating and supplying waste sludge to be recycled to at least one of the manifolds of the multilayer headbox.

Fig. 1



Description

[0001] The invention relates to a waste sludge recycling apparatus for a multilayer headbox being capable of supplying liquids onto a wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds to form corresponding layers of the multilayer fiber web in a forming section of a fiber web making machine, and to a waste sludge recycling method for forming a multilayer fiber web.

[0002] In recent years, fiber web waste sludge (in the following simply referred to as "waste sludge") such as reject, fines or other materials which are of low quality and are thus not used anymore in the process of manufacturing of fiber web in fiber web plants was deposited at waste dumpsites and/or used as construction material, for example as ground material, in road building. Such a use of waste sludge was uncomplicated and cheap since only storage places have to be provided in fiber web mills before the waste sludge is transported away by trucks and/or railway to waste dumpsites or road building facilities. Thus, the building size of the fiber web plants does not increase.

[0003] However, since the environmental specifications have been tightened in many countries during the last years, depositing and the use as construction material of waste sludge coming from fiber web plants became illegal or preparation requirements of waste sludge before it can be deposited or used as construction material are cost-intensive and thus being economically unviable.

[0004] Thus, there is a demand to provide an alternative and cost-efficient use of waste sludge in process of manufacturing of fiber web.

Summary of the invention

[0005] The inventors of the present invention have surprisingly found that it is possible to maintain strength of a multilayer fiber web, for example, a multiply board web, by even directly adding waste sludge, which has not been used by now in the process of manufacturing of fiber web in fiber web plants, into the layers of the fiber web to be formed in a forming section of the fiber web plant.

[0006] Thus, if it was possible to provide (directly add) the waste sludge into layers of the fiber web to be formed, the strength properties of the fiber web could be maintained or even slightly improved compared to the case in which only filler materials are added to the fiber web. Thus, a specified amount of waste sludge can be added to the fiber web while the strength properties of the fiber web can be maintained in the required range.

[0007] It is therefore the object of the present invention to provide a new waste sludge recycling apparatus and a new waste sludge recycling method for forming a multilayer fiber web by which an efficient and alternative use of waste sludge can be attained and quality of the fiber web is maintained.

[0008] The object of the present invention is achieved

by a waste sludge recycling apparatus having the features of claim 1 and by a method for recycling of waste sludge having the features of claim 13.

[0009] Further advantageous developments of the present invention are defined in the dependent claims.

[0010] According to an aspect of the present invention, a waste sludge recycling apparatus for a multilayer headbox being capable of supplying liquids onto a wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds to form corresponding layers of the multilayer fiber web in a forming section of a fiber web making machine is provided. The apparatus comprises a waste sludge recirculation means configured to be connected to at least one of the manifolds of the multilayer headbox for supplying waste sludge to be recycled to the at least one of the manifolds.

[0011] Accordingly, since the inventors of the present invention have found that it is possible to maintain the fiber web strength by adding waste sludge such as reject, fines or other materials which are of low quality, to layers of the web to be formed, the above waste sludge recycling apparatus for a multilayer headbox is provided. This waste sludge recycling apparatus is directly connectable to the multilayer headbox being capable of supplying liquids (such as fiber pulp suspension including fibers, refined fibers, fillers, starch and/or water) onto a wire in a layered manner for forming the multilayer fiber web and including the plurality of manifolds to form corresponding layers of the multilayer fiber web. In particular, the waste sludge recycling apparatus comprises the waste sludge recirculation means (including, for example, a piping or line system for supplying waste sludge to be recycled) configured to be connected to at least one of the manifolds of the multilayer headbox. The direct connection of the waste sludge recirculation means to the at least one manifold includes any pipe or line fitting arrangement which is suitable for supplying the waste sludge to be recycled directly into the at least one of the manifolds. This direct connection and supply to the manifold(s) of the multilayer headbox achieves the effect of sufficiently mixing the waste sludge with the fiber pulp suspension directly before being supplied onto the wire in a layered manner. Thus, up to an amount of 5 - 15% of waste sludge compared to the total amount fiber pulp suspension (stock suspension) thus can be supplied and added to the respective layers of the multilayer fiber web. Thus, on the one hand, alternative use of waste sludge can be provided and, on the other hand, the amount of pulp can be reduced by maintaining the strength of the fiber web. Furthermore, a further preparation of the waste sludge for disposal or for adding it to a raw material in a stock preparation plant of a forming section can be avoided. Thus, the cost for such a preparation can be saved.

[0012] In general, the present invention will be useable with any multilayer headbox being capable of supplying liquids onto a wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds to form corresponding layers of the multilayer fiber web in

a forming section of a fiber web making machine. In each of these manifolds, good distribution of the substances in the respective liquids takes place caused by the generated turbulence in the manifolds. Thus, the supplied waste sludge can be suitably mixed with the respective liquids (fiber pulp suspension, water, etc.) in a feed line in and directly before the manifolds. For example, the waste sludge recirculation means is connectable (i.e. mountable, attachable, fixable, etc.) to the respective headbox manifold to which white water and/or stock suspension is to be supplied, i.e. the waste sludge being supplied by the waste sludge recirculation means is mixed with the white water and/or stock suspension in the feed line for the water and/or stock suspension and/or direct in the headbox. In any case, the waste sludge recirculation means is configured to be directly connected (mounted, fixed, attached) to at least one of the manifolds of the multilayer headbox and/or the mentioned feed line just (directly) before the respective liquid flows into the manifold(s) for further mixing the waste sludge and the white water and/or stock suspension.

[0013] Furthermore, since such a headbox has a vane construction by which at boundaries of the fiber web, suspension layers to be formed the respective layers do not get mixed with adjacent fiber web suspension layers. Thus, the individual fiber web suspension layers stay separated from each other in the multilayer headbox. Accordingly, the different fiber web suspension layers can be supplied to a wire in a forming section in a layered manner, thus maintaining the purity and characteristic of the individual liquid layers.

[0014] Preferably, the plurality of manifolds of the multilayer headbox includes at least a bottom manifold to form a bottom layer of the fiber web, a middle manifold to form a middle layer of the fiber web, and a top manifold to form a top layer of the fiber web, and the waste sludge recirculation means is configured to be connected to the middle manifold of the multilayer headbox for supplying waste sludge to be recycled to the middle manifold.

[0015] In particular, it has been found that, in a case where waste sludge has been added directly in the middle of the fiber web to be formed, the fiber web strength can suitably be maintained. Accordingly, the waste sludge recirculation means is preferably configured to be connected to at least the middle manifold of the multilayer headbox. Thus, providing a direct connection of the waste sludge recirculation means at the middle manifold of the multilayer headbox can reduce production costs of fiber web, since a reduced amount of fiber pulp suspension is used. In other words, an amount of waste sludge of 5 - 15% in the middle layer can be achieved, since by adding such an amount of waste sludge strength of fiber web can be maintained and waste sludge is comparably cheap with respect to common fillers, starch or refined fibers. Even more, in case multiply board as the fiber web is to be formed, in which board the middle layer of the web is commonly a water layer, it is advantageous that waste sludge in the amount of 5 - 15% of the total

amount of materials of the layer can be added to the middle layer (here the water layer, for example white water layer) in order to provide a suitable recycling process for the waste sludge. This adding of waste sludge to the water layer is acceptable in view of purity and quality of the multiply board, wherein the strength of the board can be maintained or slightly increased due to the adding of the waste sludge.

[0016] A preferable solution is that white water is fed to the middle manifold of the headbox which may be directly taken from a white water pit in the forming section. In this case, there is no need to provide a main stock feed line connection for the waste sludge recirculation means to mix the waste sludge into that line; i.e. the waste sludge recirculation means is connected with said manifold so that the supplied waste sludge is mixed with the white water to form the middle layer inside the fiber web. In this respect, the inventors have found that, since a white water layer consistency is so low (fiber consistency of white water is less than 0.5%) that it would not form a separate fiber layer but it is sufficient to separate bottom and top layers of the fiber web from each other, when adding waste sludge to this middle layer, the waste sludge stably remains in this layer and thus between the bottom and top layers. Thus, an amount of waste sludge of 5 - 15% in the middle layer can be preferably added. It is also possible to add chemicals, etc. to this "white water layer" for improving web properties and quality.

[0017] It is also possible that a typical stock suspension (fiber pulp suspension) is supplied to the middle manifold and thus the waste sludge supplied via the waste sludge recirculation means connected to said manifold of the headbox is mixed into the fiber pulp suspension to form the middle layer of the fiber web.

[0018] Preferably, the waste sludge recirculation means includes a waste sludge recirculation line, a waste sludge recirculation control valve for adjusting an amount of waste sludge to be supplied to the respective manifold(s), and a waste sludge feeding pump for feeding the waste sludge to the manifold. Here, under consideration of the quality of raw material for forming the fiber web, the quality and content of the fiber pulp suspension being, for example, produced in a stock preparation plant, the quality of the web to be formed, etc., a desired amount of waste sludge can be supplied to the respective manifold(s). That is, the amount and flow speed of the waste sludge to be supplied to the headbox can suitably be adjusted by means of the waste sludge feeding pump and the waste sludge recirculation control valve. For example, the valve and the pump can be turned off in case the fiber pulp suspension has already a content at its lower quality range. Thus, supply of waste sludge can suitably be controlled.

[0019] Preferably, each of the manifolds of the multilayer headbox has a diffuser as a turbulence generator creating turbulence in liquids supplied into each respective manifold, each of the diffusers having an outlet into a nozzle chamber of the multilayer headbox. Each of

these diffusers creates turbulence in liquids supplied into each respective diffuser. Thus, since the waste sludge recirculation means is to be connected to the respective manifolds, the waste sludge can directly be supplied into the manifolds and, thus, to the diffusers in which due to the creating turbulence the supplied liquids are suitably mixed before they are to be supplied onto a wire in a layered manner.

[0020] Preferably, the waste sludge recirculation means includes a separating means for separating fines from white water of the fiber web making machine, the separating means being configured to be connected to the at least one of the manifolds of the multilayer headbox to supply the fines to the at least one of the manifolds. According to this preferred arrangement of the present invention, the separated fines can directly be supplied to the at least one of the manifolds. Thus, the waste sludge can already be pre-cleaned and filtered so that waste water cleaning and waste sludge disposal process of the whole fiber web making machine can be further optimized.

[0021] Preferably, the separating means includes a clarifier, preferably a disc filter, separating the fines from the white water. Commonly known disc filters have a high capacity for cleaning fines from white water so that they are preferably used for separating the fines from the white water.

[0022] Preferably, the separating means further includes a fines recirculation line connecting the clarifier with the at least one of the manifolds of the headbox, a fines recirculation control valve for adjusting an amount of fines to be supplied to the respective manifold(s), and a fines feeding pump for feeding the fines to the manifold(s) via the fines recirculation line. Here, under consideration of the quality of raw material for forming the fiber web, the quality and content of the fiber pulp suspension being, for example, produced in a stock preparation plant, the quality of the web to be formed, etc., a desired amount of fines can be supplied to the respective manifold(s). That is, the amount and flow speed of the fines to be supplied to the headbox can suitably be adjusted by means of the fines feeding pump and the fines recirculation control valve. Thus, supply of fines can be suitably controlled.

[0023] Preferably, the waste sludge recycling apparatus further comprises a waste water treatment means in which waste water from the fiber web making machine and/or recycled fiber plant and/or stock preparation plant is collected and clarified, the waste water treatment means including a flotation means for separating the waste sludge from the waste water, and the flotation means being connected to the waste sludge recirculation means to supply the separated waste sludge to the at least one of the manifolds of the multilayer headbox.

[0024] Preferably, the waste sludge recirculation means further includes a waste sludge recirculation line connecting the flotation means with the at least one of the manifolds of the headbox, a waste sludge recircula-

tion control valve for adjusting an amount of waste sludge to be supplied to the manifold, and a waste sludge feeding pump for feeding the waste sludge to the manifold via the waste sludge recirculation line. Accordingly, due to the provision of such a waste sludge recirculation control valve and feeding pump, an appropriate amount of waste sludge to be supplied to the manifold can be suitably adjusted, for example, on the basis of quality of raw material for forming the fiber web, the quality and content of the fiber pulp suspension being, for example, produced in a stock preparation plant, the quality of the web to be formed, etc. Thus, the amount and flow speed of the waste sludge to be supplied to the headbox can be suitably controlled and adjusted by means of the waste sludge feeding pump and the waste sludge recirculation control valve.

[0025] Preferably, the waste water treatment means and the separating means are connected with the at least one of the manifolds of the headbox via a common supply line merging the waste sludge recirculation line and the fines recirculation line. Thus, structure of the line system can be simplified and its installation size can be kept compact. Further, in the common supply line, the amounts of fines and waste sludge can be pre-mixed before they are entering the respective manifold of the headbox.

[0026] Preferably, the separating means is configured to be connected to a twin-wire former or a fourdrinier former for recirculating white water cleaned by the separating means to the gap former or the hybrid former as process water of the forming section. Here, the thus cleaned and recirculated white water can be used as process water in the forming section, preferably it is used as so-called "shower water" in the twin-wire former or fourdrinier former in order to decrease the amount of fresh water to be used in such formers.

[0027] Preferably, a forming section of a fiber web making machine is provided, which comprises at least one wire arranged in a wire loop for forming a fiber web from a fiber suspension, a multilayer headbox being capable of supplying liquids onto the wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds to form corresponding layers of the multilayer fiber web, and the waste sludge recycling apparatus according to the present invention. According to the above-described forming section using the waste sludge recycling apparatus according to the present invention, any of the advantages described above with regard to the waste sludge recycling apparatus according to the invention can suitably be achieved.

[0028] According to another aspect of the present invention, a waste sludge recycling method for forming a multilayer fiber web is provided. The method comprises the steps of supplying liquids in a layered manner onto a wire of a forming section of a fiber web making machine via a multilayer headbox including a plurality of manifolds to form corresponding layers of the multilayer fiber web, and recirculating and supplying waste sludge to be recycled to at least one of the manifolds of the multilayer

headbox.

[0029] Preferably, the layers are formed onto the wire via the plurality of manifolds including at least a bottom manifold to form a bottom layer of the fiber web, a middle manifold to form a middle layer of the fiber web, and a top manifold to form a top layer of the fiber web, and thus comprising at least the bottom layer, the middle layer, and the top layer, the bottom layer and the top layer being separated by the middle layer, and the waste sludge to be recycled is recirculated and supplied to the middle manifold to form the middle layer of the fiber web.

[0030] According to the method of the invention, waste sludge is directly added (recycled) to the at least one of the manifolds of the headbox so that the waste sludge can be directly mixed with the liquid (i.e. fiber pulp suspension, water, etc.) in said manifold(s) before supplying the thus mixed liquid including the waste sludge by means of the headbox to form corresponding layers of a multilayer web.

[0031] According to the above described method and the advantageous alternatives, the advantages described above with regard to the waste sludge recycling apparatus according to the invention can be achieved.

[0032] Further advantages will be understood from the following description of presently preferred embodiments of the invention to be considered in connection with the attached drawing.

[0033] Fig. 1 is a schematic view of a forming section of a fiber web making machine in which a waste sludge recycling apparatus for a multilayer headbox being capable of supplying liquids onto a wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds to form corresponding layers of the multilayer fiber web according to an embodiment of the invention is used.

[0034] In Fig. 1, the forming section of a fiber web making machine is schematically shown.

[0035] The forming section comprises a web forming machine (liner machine) 10, in which a headbox 20 is included. The web forming machine may be provided as a twin-wire former or a fourdrinier former.

[0036] In Fig. 1, for illustrative reasons, the headbox 20 is separately illustrated from the web forming machine 10. However, it is to be understood that, in general, the headbox 20 may form an integral or separate part of the web forming machine 10.

[0037] The headbox 20 shown in Fig. 1 is a multilayer headbox 20 which inter alia includes a bottom manifold 201, a middle manifold 202 and a top manifold 203. The multilayer headbox 20 is capable of supplying liquids (such as fiber pulp suspension including fibers, refined fibers, fillers, starch and/or water) onto a wire (not shown) in a layered manner for forming a multilayer fiber web (not shown). Here, the multilayer headbox 20 includes the bottom manifold 201 to form a bottom layer of the fiber web, the middle manifold 202 to form a middle layer of the fiber web, and the top manifold 203 to form a top layer of the fiber web.

[0038] Furthermore, the forming section shown in Fig. 1 includes a stock preparation plant (means) 40 to which raw material 50 consisting of, for example, fresh fibers, recycled fibers, old carton boards, old papers, etc. for forming a stock preparation in the stock preparation plant 40 is supplied. In this stock preparation plant 40, a fiber pulp including fibers, refined fibers, fillers, starch and/or water or the like is generated in a known manner. Therefore, the supply of the raw material 50 to the stock preparation plant 40 as well as the structure and functions of the stock preparation plant 40 for generating the fiber pulp are generally known and are not further described.

[0039] Furthermore, the web forming section shown in Fig. 1 also includes a waste water treatment means 60 including a flotation means 601 and an aerobic treatment means 602.

[0040] As shown in Fig. 1, the stock preparation plant 40 is connected with the waste water treatment means 60 via a waste water and sludge feeding line 401 (see thin solid line in Fig. 1 reaching from the stock preparation plant 40 to the waste water treatment means 60). This waste water and sludge feeding line 401 supplies waste water including waste sludge (fiber web waste sludge) generated as excess material in the stock preparation plant 40 to the flotation means 601 of the waste water treatment means 60. Here, the flotation means 601 separates the waste sludge from the waste water in a usual flotation process.

[0041] Furthermore, also the web forming machine 10 is connected to the waste water treatment means 60, in particular to the flotation means 601 of the waste water treatment means 60, via a waste water and sludge feeding line 305 (see thick solid line in Fig. 1 reaching from the web forming machine 10 to the waste water treatment means 60). This waste water and sludge feeding line 305 supplies waste water and waste sludge from the web forming machine 10 to the flotation means 601 in order to separate the waste sludge from the waste water within the flotation means 601.

[0042] After the flotation process, the waste sludge has been separated from the waste water and the waste water is further supplied to the aerobic treatment means 602 in order to clarify the waste water under aerobic conditions within the aerobic treatment means 602. The thus clarified water can be fed again as process water into the forming section of the fiber web making machine, for example.

[0043] As already indicated above, disposal of the fiber web waste sludge including, for example, reject, fines or other materials, becomes more and more difficult due to legally tightened environmental specifications in the last years.

[0044] Therefore, according to the present invention, to provide an alternative and cost-efficient use of the waste sludge in the process of manufacturing the fiber web, in particular in the forming section of the fiber web making machine, the waste water treatment means 60 is (directly) connected to the headbox 20 via a waste

sludge recirculation means (forming a "waste sludge recycling apparatus") for supplying waste sludge to be recycled from the waste water treatment means 60 to the headbox 20.

[0045] As shown in Fig. 1, for supplying the waste sludge to be recycled to the headbox 20, a waste sludge recirculation line 603 is provided between the waste water treatment means 60 and the headbox 20. Here, the waste sludge recirculation line 603 is connected to a white water and/or stock suspension feeding line 30 in which white water and/or stock suspension (fiber suspension) is fed to the headbox 20, in particular, to the middle manifold 202 of the headbox 20. The waste sludge recirculation line 603 contains the waste sludge supplied from the flotation means 601 and is mixed with the white water and/or stock suspension fed in the white water and/or stock suspension feeding line 30 upstream of the headbox 20, i.e. directly (immediately) before the manifold 202. Thus, the waste sludge recirculation line 603 is connected to the flotation means 601 and to the middle manifold 202 of the headbox 20.

[0046] The waste sludge recirculation line 603 may be directly connected to at least one of the manifolds 201 to 203 of the headbox 20.

[0047] According to the invention as indicated above, it is sufficient that the waste sludge recirculation means is connected to at least one of the manifolds 201 to 203 of the headbox 20 for supplying the waste sludge to be recycled to the at least one of the manifolds 201 to 203.

[0048] In addition or alternative, as shown by the chain dotted lines in Fig. 1, a separating means for separating fines from excess white water (waste water) from the web forming machine 10 can be provided. When such a separating means is provided and connected to the web forming machine, this separating means includes a clarifier 301 or filter means 301 for separating the fines from the white water. The clarifier may be a commonly known disc filter having a high capacity for cleaning fines from white water so that such a filter constitution is preferably used for separating the fines from the white water.

[0049] As shown in Fig. 1, the clarifier 301 is connected to the web forming machine 10 via an excess white water feeding line 304 for feeding the excess white water from the web forming machine 10 to the clarifier 301. In the clarifier 301, the excess white water is separated into fines (which are part of "fine sludge" of the waste sludge) and clarified white water.

[0050] The clarified white water can be supplied (recycled, recirculated) back to the web forming machine 10 via a white water recirculation line 303. This white water recirculation line 303 acts as a process water recirculation line.

[0051] Preferably, the separating means is configured to be connected to a twin-wire former or a fourdrinier former as the web forming machine for recirculating white water cleaned by the separating means to the gap former or the hybrid former as process water of the forming section. Thus, the cleaned and recirculated white water can

be used as process water in the forming section; preferably it is used as so-called "shower water" in the twin-wire former or fourdrinier former in order to decrease the amount of fresh water to be used in such formers.

[0052] Furthermore, the fines being separated within the clarifier 301 from the white water (process water) can directly be supplied to the headbox 20 via a fines recirculation line 302. Thus, the fines are supplied to the headbox via the fines recirculation line 302 being connected to the white water and/or stock suspension feeding line 30 so that the fines can be mixed in a similar way as the waste sludge solely or in addition to the mixing of the waste sludge with the white water and/or stock suspension directly before feeding the thus mixed liquid to the headbox 20.

[0053] In the separating means, the fines recirculation line 302 may be directly connected to at least one of the manifolds 201 to 203 of the headbox 20.

[0054] As shown in Fig. 1, here, the fines recirculation line 302 is connected to the waste sludge recirculation line 603 at an upstream part of the middle manifold 202 of the headbox 20. That is, the waste water treatment means 60 and the separating means are connected with at least one of the manifolds 201 to 203 of the headbox 20 via a common supply line 400 merging the waste sludge recirculation line 603 and the fines recirculation line 302. For this arrangement, the fines can be separated in the separate clarifier 301 without being supplied to the waste water treatment means 60 so that the fines to be separated in the clarifier 301 can directly be supplied to the headbox 20. In the common supply line 400, the amounts of fines and waste sludge can be pre-mixed before they are entering the respective manifold of the headbox 20.

[0055] Besides, although it is not shown in Fig. 1, the waste sludge recirculation means including the waste sludge recirculation line 603 may also include a waste sludge recirculation control valve (not shown) for adjusting an amount of waste sludge to be supplied to the manifold 202 and a waste sludge feeding pump (not shown) for feeding the waste sludge to the manifold 202. Accordingly, due to the provision of such a waste sludge recirculation control valve and feeding pump, an appropriate amount of waste sludge to be supplied to the manifold 201 can suitably be adjusted in a known manner, for example, on the basis of quality of raw material for forming the fiber web, the quality and content of the fiber pulp suspension being, for example, produced in the stock preparation plant 40, the quality of the web to be formed, etc. That is, the amount and flow speed of the waste sludge to be supplied to the headbox 20 can suitably be adjusted by means of the waste sludge feeding pump and the waste sludge recirculation control valve. Thus, supply of waste sludge can suitably be controlled. Furthermore, the separating means including the fines recirculation line 302 connecting the clarifier 301 with the headbox 20 may include a fines recirculation control valve (not shown) for adjusting an amount of fines to be

supplied to the manifold 201 and a fines feeding pump (not shown) for feeding the fines to the manifold 201 via the fines recirculation line 302. Thus, the feeding amount of fines to be supplied to the manifold 202 and separated within the clarifier 301 from the excess white water can suitably and independently be adjusted by the fines recirculation control valve from the supply of the waste sludge including rejects via the waste sludge recirculation line 603. For example, the feeding amount of fines can be controlled from 0 to 100% by adjusting the valve position of the fines recirculation control valve and/or the feeding amount of waste sludge can be controlled from 0 to 100% by adjusting the waste sludge recirculation control valve as well.

[0056] Furthermore, the forming section may further comprise at least one wire arranged in a wire loop for forming a fiber web from a fiber suspension, onto which wire the headbox is capable of supplying liquids onto the wire in a layered manner for forming a fiber web on the wire.

[0057] The above described multilayer headbox according to the present embodiment is a three-layer headbox. However, the multilayer headbox may also be formed as a two-layer headbox or as a headbox suitable for forming more than three layered fiber web.

[0058] It is also possible that the waste sludge may come directly, i.e. may be supplied from a recycled fiber plant (for example from OCC-/DIP-plants) via the waste sludge recycling apparatus (forming) as the waste sludge recirculation means to the manifold(s) of the headbox. Preferably, this waste sludge may be separated before the waste water treatment means and directly supplied to the manifold(s) via, for example, separate waste sludge recirculation lines of the waste sludge recirculation means.

[0059] According to the invention, a structure for direct connection between the web forming machine (liner machine), the recycled fiber plant and/or the waste water treatment means or the like for supplying waste sludge to at least one of the manifolds of the multilayer headbox is provided.

[0060] While the above description was given on the basis of presently preferred embodiments, it is to be understood that the scope of the invention is not limited to the above, but is defined by the appending claims.

Claims

1. A waste sludge recycling apparatus for a multilayer headbox (20) being capable of supplying liquids onto a wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds (201, 202, 203) to form corresponding layers of the multilayer fiber web in a forming section of a fiber web making machine, comprising:

a waste sludge recirculation means configured

to be connected to at least one of the manifolds (201, 202, 203) of the multilayer headbox (20) for supplying waste sludge to be recycled to the at least one of the manifolds (201, 202, 203).

2. The waste sludge recycling apparatus according to claim 1, wherein the plurality of manifolds (201, 202, 203) of the multilayer headbox (20) includes at least a bottom manifold (201) to form a bottom layer of the fiber web, a middle manifold (202) to form a middle layer of the fiber web, and a top manifold (203) to form a top layer of the fiber web, and the waste sludge recirculation means is configured to be connected to the middle manifold (202) of the multilayer headbox (20) for supplying waste sludge to be recycled to the middle manifold (202).
3. The waste sludge recycling apparatus according to claim 1 or 2, wherein the waste sludge recirculation means includes a waste sludge recirculation line (30), a waste sludge recirculation control valve for adjusting an amount of waste sludge to be supplied to the at least one of the manifolds (201, 202, 203), and a waste sludge feeding pump for feeding the waste sludge to the at least one of the manifolds (201, 202, 203).
4. The waste sludge recycling apparatus according to any of the preceding claims, wherein each of the manifolds (201, 202, 203) of the multilayer headbox (20) has a diffuser as a turbulence generator creating turbulence in liquids supplied into each respective manifold (201, 202, 203), each of the diffusers having an outlet into a nozzle chamber of the multilayer headbox (20).
5. The waste sludge recycling apparatus according to any of the preceding claims, wherein the waste sludge recirculation means includes a separating means (301) for separating fines from white water of the fiber web making machine, the separating means (301) being configured to be connected to the at least one of the manifolds (201, 202, 203) of the multilayer headbox (20) to supply the fines to the at least one of the manifolds (201, 202, 203).

6. The waste sludge recycling apparatus according to claim 5, wherein the separating means (301) includes a clarifier, preferably a disc filter, separating the fines from the white water.

7. The waste sludge recycling apparatus according to claim 6, wherein the separating means (301) further includes a fines recirculation line (302) connecting the clarifier with the at least one of the manifolds (201, 202, 203) of the headbox (20), a fines recirculation control valve for adjusting an amount of fines to be supplied to the at least one of the manifolds

(201, 202, 203), and a fines feeding pump for feeding the fines to the at least one of the manifolds (201, 202, 203) via the fines recirculation line (302).

8. The waste sludge recycling apparatus according to any of the preceding claims, further comprising a waste water treatment means (60) in which waste water from the fiber web making machine and/or recycled fiber plant and/or stock preparation plant is collected and clarified, the waste water treatment means (60) including a flotation means (601) for separating the waste sludge from the waste water, and the flotation means (601) being connected to the waste sludge recirculation means to supply the separated waste sludge to the at least one of the manifolds (201, 202, 203) of the multilayer headbox (20).
9. The waste sludge recycling apparatus according to claim 8, wherein the waste sludge recirculation means further includes a waste sludge recirculation line (30) connecting the flotation means (601) with the at least one of the manifolds (201, 202, 203) of the headbox (20), a waste sludge recirculation control valve for adjusting an amount of waste sludge to be supplied to the at least one of the manifolds (201, 202, 203), and a waste sludge feeding pump for feeding the waste sludge to the at least one of the manifolds (201, 202, 203) via the waste sludge recirculation line (30).
10. The waste sludge recycling apparatus according to claim 9, wherein the waste water treatment means (60) and the separating means (301) are connected with the at least one of the manifolds (201, 202, 203) of the headbox (20) via a common supply line (400) merging the waste sludge recirculation line (30) and the fines recirculation line (302).
11. The waste sludge recycling apparatus according to any of the claims 5 to 10, wherein the separating means (301) is configured to be connected to a twin-wire former (10) or a fourdrinier former (10) for recirculating white water cleaned by the separating means (301) to the gap former (10) or the hybrid former (10) as process water of the forming section.
12. A forming section of a fiber web making machine, comprising:

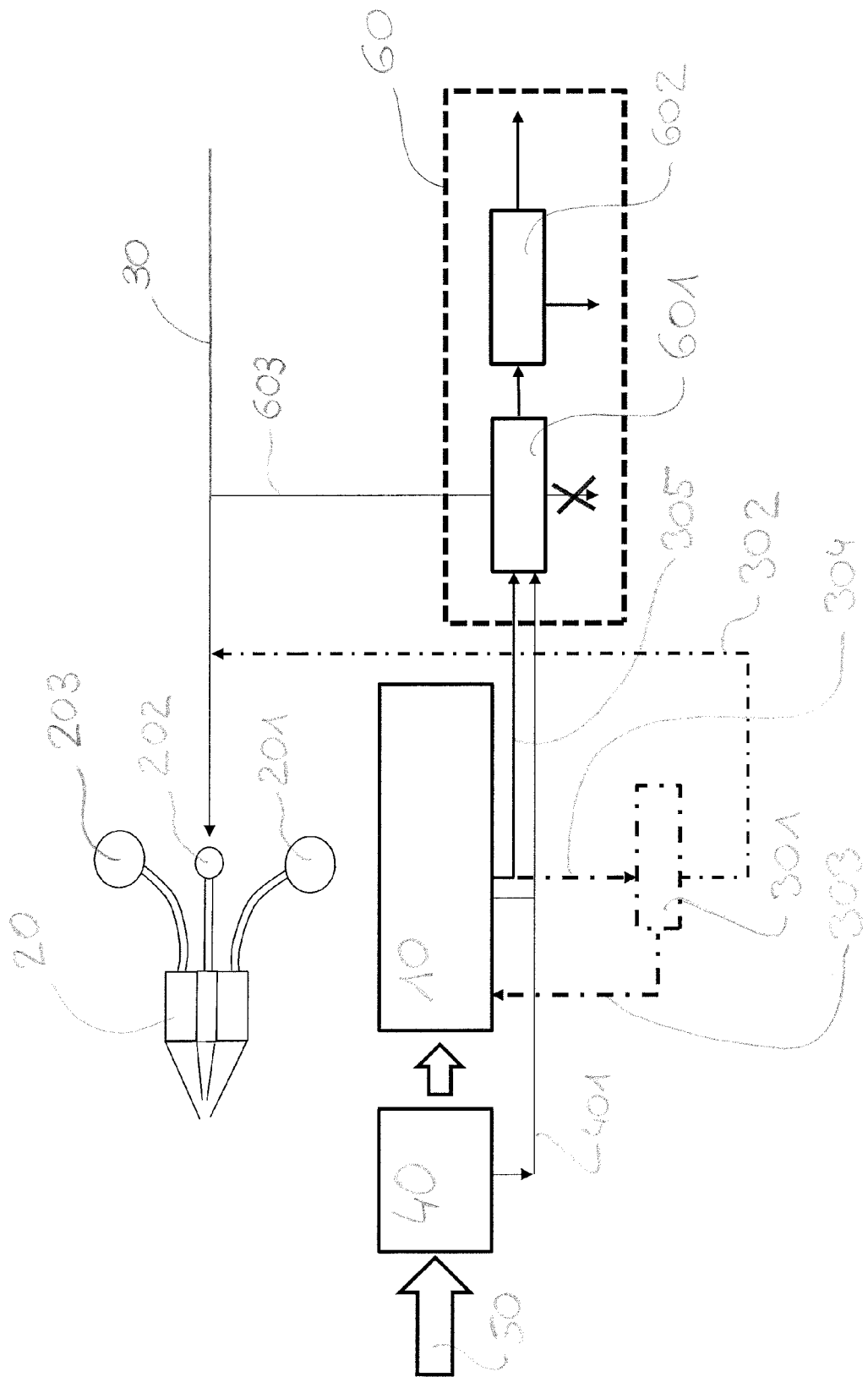
at least one wire arranged in a wire loop for forming a fiber web from a fiber suspension,
a multilayer headbox (20) being capable of supplying liquids onto the wire in a layered manner for forming a multilayer fiber web and including a plurality of manifolds (201, 202, 203) to form corresponding layers of the multilayer fiber web, and
the waste sludge recycling apparatus according

to any of the preceding claims.

13. A waste sludge recycling method for forming a multilayer fiber web, comprising:

supplying liquids in a layered manner onto a wire of a forming section of a fiber web making machine via a multilayer headbox (20) including a plurality of manifolds (201, 202, 203) to form corresponding layers of the multilayer fiber web, and
recirculating and supplying waste sludge to be recycled to at least one of the manifolds (201, 202, 203) of the multilayer headbox (20).
14. The waste sludge recycling method according to claim 13, wherein
the layers are formed onto the wire via the plurality of manifolds (201, 202, 203) including at least a bottom manifold (201) to form a bottom layer of the fiber web, a middle manifold (202) to form a middle layer of the fiber web, and a top manifold to form a top layer (203) of the fiber web, and thus comprising at least the bottom layer (201), the middle layer (202), and the top layer (203), the bottom layer (201) and the top layer (203) being separated by the middle layer (202), and
the waste sludge to be recycled is recirculated and supplied to the middle manifold (202) to form the middle layer of the fiber web.

Fig. 1





EUROPEAN SEARCH REPORT

 Application Number
 EP 14 18 9919

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 479 141 A1 (ESCHER WYSS GMBH [DE] VOITH SULZER STOFFAUFBEREITUNG [DE]) 8 April 1992 (1992-04-08)	1,4,12,13	INV. D21F1/02 D21F1/66 D21F9/00
Y	* column 2, line 39 - column 3, line 18; figure 1 *	5-7	
Y	EP 0 751 253 A2 (MARCAL PAPER MILLS INC [US]) 2 January 1997 (1997-01-02) * column 4, lines 18-45; figure 1 *	5-7	
			TECHNICAL FIELDS SEARCHED (IPC)
			D21F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 March 2015	Examiner Pregetter, Mario
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			

 1
 EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 18 9919

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-03-2015

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0479141 A1	08-04-1992	DE 4031310 A1	16-04-1992
		EP 0479141 A1	08-04-1992

EP 0751253 A2	02-01-1997	AR 002418 A1	11-03-1998
		AU 707591 B2	15-07-1999
		AU 5479096 A	19-12-1996
		CA 2176435 A1	08-12-1996
		EP 0751253 A2	02-01-1997
		EP 0928842 A2	14-07-1999
		JP 3012196 B2	21-02-2000
		JP H09176981 A	08-07-1997
		NO 962375 A	09-12-1996

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82