(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 484 149 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.01.2025 Bulletin 2025/01

(21) Application number: **24183317.7**

(22) Date of filing: **20.06.2024**

(51) International Patent Classification (IPC):
B31F 1/28 *(2006.01)* ***F28B 9/08*** *(2006.01)*
F28D 21/00 *(2006.01)* ***F01K 17/00*** *(2006.01)*
F22D 1/18 *(2006.01)* ***F28F 17/00*** *(2006.01)*
F01K 15/00 *(2006.01)* *F28D 7/00* *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B31F 1/2818; B31F 1/28; B31F 1/285; F01K 15/00; F28D 1/0472; F28D 21/0014; F28F 17/005

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **20.06.2023 IT 202300012699**

(71) Applicant: **Rivolta, Giorgio**
20090 Monza (MB) (IT)

(72) Inventor: **Rivolta, Giorgio**
20090 Monza (MB) (IT)

(74) Representative: **Rossi, Ugo**
Racheli S.r.l.
Viale San Michele del Carso, 4
20144 Milano (IT)

(54) PROCESS FOR MANUFACTURING CORRUGATED CARDBOARD

(57) The present invention relates to a process for manufacturing corrugated cardboard with improved efficiency in terms of recovering and reusing the heat generated by the plant. In particular, the invention relates to a process for recovering heat and condensate from the cabins containing the corrugating cylinders and the gluing machine, in order to obtain a source of hot water to be used in part in the glue preparation equipment necessary for gluing the different layers that form the corrugated cardboard.

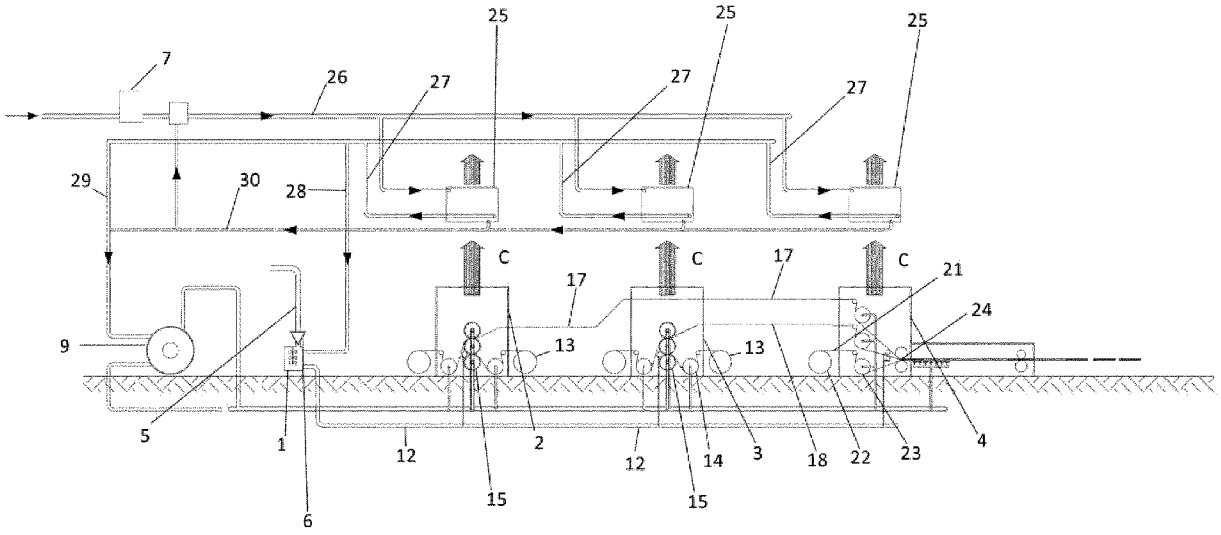

FIG. 2

EP 4 484 149 A1

Description

FIELD OF APPLICATION

[0001] The present invention relates to a process for manufacturing corrugated cardboard with improved efficiency in terms of recovering and reusing the heat generated by the plant.

[0002] In particular, the invention relates to a process for recovering heat and condensate from the soundproofing cabins installed on the corrugators and the gluing machine, which are used for corrugating the cardboard sheets, in order to obtain a source of hot water to be used mainly in the glue preparation equipment necessary for gluing the various layers making up the corrugated cardboard, and for replenishing the boiler for producing the steam necessary for heating all the rollers of the corrugators.

PRIOR ART

[0003] As is well known, corrugated cardboard is a layered material consisting of two sheets of flat cardboard (the covers) and one or more sheets of corrugated cardboard, which are held together by natural glues derived from corn or potato starch. If there are more than two sheets of corrugated cardboard, another sheet of flat cardboard called the central corrugated sheet is interposed between one and the other. Hence, this can be called corrugated cardboard with a single, double wave etc.

[0004] Each of the components that make up a certain type of corrugated cardboard can be different in terms of material, thickness and weight and together with the other components it influences the characteristics of the finished product.

[0005] Plants for the production of corrugated cardboard typically have two sections, called the "wet section" and the "dry section". The first part of the plant, the so-called "wet section", comprises the members that, starting from single sheets of smooth board, form a corrugated board with two or more layers alternating between smooth and corrugated sheets. This section of the plant also includes the gluing section between the different cardboard sheets, so it comprises a large number of pieces of equipment, which must be heated to a high temperature to effectively perform the required operations on the cardboard sheets.

[0006] Typically, the "wet section" comprises unwinders for reels of smooth board, singlesided machines with heating rollers and corrugating rollers to form a layer of corrugated cardboard and join a layer of smooth cardboard to it. The "wet" section also comprises gluing units and so-called heated plate units for joining several layers of corrugated cardboard together.

[0007] The various equipment in the plant (heating rollers, corrugating rollers, heating plates) must be kept at the right temperature to heat the cardboard, therefore they are normally connected to a circuit for the circulation of steam, which is the heat transfer fluid.

[0008] For the production of simple corrugated cardboard (i.e. single-wave) it is sufficient to have only one corrugating unit (usually fed by two reels). For the production of double- or triple-wave board, it is necessary to have a second corrugating unit and the associated services, reel holders, preheaters, pre-conditioners inserted between the first unit and the gluing unit of the various layers. The corrugating unit is fed with the paper for corrugating from the preconditioner.

[0009] The system allows the corrugating rollers to shape the paper using mechanical energy (pressure between the cylinders) and thermal energy (heat from the cylinders). The corrugation is formed at the point of contact between the two overlapping rotating rollers.

[0010] Cardboard production equipment, like many industrial plants, is characterised by intense noise during its operation due to the presence of a large number of continuously moving rollers. They are therefore equipped with silencing devices in order to intervene as far as possible on the direct sources of noise. It is also necessary to intervene on the transmission and propagation of noise in order to achieve a noiseisolating effect as far as possible.

[0011] For this reason, entire corrugated cardboard production lines, or individual machines, are placed in soundproof cabins made of sound-absorbing materials, so that sound energy cannot propagate beyond the walls and ceiling and spread into the surrounding environment.

[0012] These soundproofing cabins are carefully designed to achieve effective noise attenuation. The internal structure is composed of panels of sound-absorbing material, while the external structure is composed entirely of painted or galvanised sheet metal panels to withstand corrosive agents. Noise is thus absorbed by these sound-absorbing panels, which also have high thermal insulation.

[0013] As a result, there is an additional temperature increase inside the soundproofing cabins due to the lower thermal energy dispersion caused by the presence of the sound-absorbing panels. Generally, soundproofing cabins are equipped with devices to lower the temperature and keep it within a desired range of values.

[0014] In almost all corrugated cardboard plants, steam from a boiler is circulated through the corrugating rollers and heating plates at high operating pressure. Circulating through the equipment members, the steam transfers heat to the cardboard to condition it. Part of the steam forms condensate inside the mechanical members (corrugating rollers), which is collected in a condensate recovery system operating at a recovery pressure below the operating pressure, so that a direct flow of condensate from the highpressure section to the low-pressure section can be achieved. From the recovery system, condensate is fed back into the boiler to obtain steam at the desired operating pressure.

[0015] This results in energy losses due to latent heat

of vaporisation and sensible heat escaping from the system through the steam vent. Since the water used in the system has been demineralized, and the loss of steam from the system therefore entails the need to replenish water, which in turn has been treated, with the consequent consumption of demineralized water and the associated costs for cleaning and demineralizing the water, the loss of steam from the system is an inconvenience in terms of energy loss. Typically in conventional systems, about 10% of the recovered condensate is discharged in the form of flash steam. A pressurised condensate exposed to atmospheric pressure has more energy than it can contain at atmospheric pressure. This excess energy is used to convert part of the condensate into steam. This phenomenon is called flashing and the steam thus generated is called flash steam.

[0016] Another drawback of a corrugated cardboard plant is that the corrugated sheet is subjected to strong thermal shocks during the process that are detrimental to the quality of the finished product. In fact, after leaving the corrugating rollers at about 100°C, the corrugated sheet undergoes rapid cooling to about 40°C, and then sudden heating from 40°C to about 90°C just before the gluing unit.

[0017] Furthermore, even within each cabin of the corrugating unit there is a noticeable drop in temperature as the ventilation system that cools the motors also cools the corrugated sheet as it exits the corrugating rollers, subjecting it to a temperature gradient that does not guarantee the uniformity of the properties of the finished product. The aforementioned cooling also represents energy expenditure in view of the fact that the gluing between the various cardboard sheets must take place at high temperatures.

[0018] In order to overcome the inconvenience of temperature changes to which the corrugated board is subjected passing from one corrugation cabin to the next, patent application IT102011901950240, in the name of the same Applicant, proposes a plant for the production of corrugated cardboard in which each corrugating unit (cabin) has an internal horizontal separator to create an upper zone at a constant temperature and without air suction, where the corrugated sheet coming out of the corrugating rollers passes, and a lower zone where the corrugating rollers are located, placed under suction to extract the heated air through a vertical suction duct at the rear of the cabin, not connected to said upper zone.

[0019] The production plant described in IT102011901950240 also includes a system for recovering the hot air leaving each corrugation cabin, which is sent to an air/air heat exchanger that supplies it to the building for heating the rooms during the winter months. This system is also equipped with another air/water heat exchanger for heating hot water for the utilities of the building containing the system.

[0020] However, in the summer months, when it is not necessary to heat the rooms in the building, this solution requires a by-pass to the air/air heat exchanger in order to release the hot air from the ducts of the individual cabins into the atmosphere.

[0021] Consequently, the production system according to the above-mentioned Italian patent has the drawback of not efficiently utilising the heat leaving the corrugation cabins, and also of not providing for an alternative use of the recovered heat during the summer months by dispersing the hot air leaving the cabins into the environment. There is also no provision for the recovery of the condensate and thus of the water produced by the heat exchangers at the exit of the above-mentioned processing cabins.

[0022] In recent years, as energy prices have risen, efforts have been made to limit the amount of resources used in industrial plants in order to reduce production costs and energy waste.

[0023] In addition, as a result of global warming issues for the protection of the environment, there is a need to save as much water resources as possible, and consequently save on the costs of treating/demineralizing water in order to be able to use it in the corrugated cardboard production process.

[0024] In light of the above, the need is perceived for a plant capable of increasing the efficiency of the corrugated cardboard production process, so as to minimise thermal energy waste and excessive water consumption.

[0025] The Applicant has found that the technical drawbacks highlighted above can be easily solved by the innovative process proposed in this patent application.

[0026] A first object of the present invention is to realise a method for recovering waste heat from the operation of a corrugated cardboard production plant of the type described above, by using the recovered heat to heat both the water intended for the production unit of the adhesive agent for gluing the different sheets of corrugated cardboard, and the water required for replenishing the boiler.

[0027] A second purpose of the invention is to make a quantity of demineralized water (already purified) available to the production plant in question through the recovery of condensate from the heat exchangers, thus reducing treatment costs and also the quantity of water resources required for the process.

[0028] The Applicant has devised, tested and embodied the present invention to overcome the above-mentioned shortcomings of the state of the art and to obtain these and other objects and advantages.

DISCLOSURE OF THE INVENTION

[0029] The present invention is expressed and characterized in the independent claims, while the dependent claims set forth other preferred and non-essential features of the present invention, or variants of the main solution idea.

[0030] A first object of the present invention is a process for manufacturing corrugated cardboard comprising

the following steps:

A) preparing one or more corrugated sheets in one or more corrugating units by using corrugating rollers heated by steam at a temperature ranging from 100 to 160°C;
B) gluing of the corrugated sheets with a flat paper sheet by means of an adhesive agent in a gluing machine heated with steam at a temperature of between 100 and 160°C;
C) feeding the hot air coming from steps A) and B) to a sequence of heat exchangers to heat a stream of cold water coming from the external environment;

the process being characterized in that a stream of water at a temperature between 25 and 45°C, preferably 30-40°C, is obtained at the outlet of the heat exchangers, said stream of water being fed both to a mixer, for the preparation of the adhesive agent, and to a boiler used to generate the heating steam of steps A) and B).

[0031] The corrugated cardboard production plant of the present invention ensures optimal heat energy recovery, due to the fact that the heat exchangers of step C) yield heat to a cold water stream which, once heated, can be directly used in the step of preparing the adhesive agent used in the gluing section of the various sheets composing the corrugated cardboard.

[0032] According to a preferred embodiment of the present invention, the adhesive agent is prepared by mixing heated water from the heat exchangers of step C) with a powder based on vegetable starches, preferably corn starch, pea starch, potato starch.

[0033] The equipment used to carry out the corrugation A) and gluing B) steps, i.e. the preheating cylinders, the corrugating rollers, the gluing machine, need to be heated by steam at a high temperature, in the order of 100-160°C. Consequently, the air inside these cabins is subjected to strong heating.

[0034] In addition, the equipment used to carry out the corrugation A) and gluing B) steps is preferably installed inside soundproof cabins in order to reduce the noise that propagates to the outside. This further increases the temperature inside the corrugation cabins A) and gluing cabins B), due to the presence of sound-absorbing panels, which also result in high thermal insulation.

[0035] The main objective of the process according to the invention is to realise a system that, by exploiting the heat coming out of the soundproof cabins, allows energy to be recovered and the consumption of resources (raw materials, water) for the plant to be reduced.

[0036] The process of the invention makes it possible to avoid unnecessarily wasting the latent heat contained in the flow of hot air exiting the corrugating and gluing cabins.

[0037] This heat recovery has a dual use:

1) heating some of the cold water from the external environment to a temperature comprised between 25 and 45°C for use in the mixer provided for the preparation of the adhesive agent;
2) the remaining water heated to a temperature between 25 and 45°C is fed to the boiler for generating the steam required in steps A) and B).

[0038] In a typical embodiment, a corrugated cardboard production plant is provided comprising a plurality of steam-heated elements in contact with the cardboard sheets; a circuit for producing steam at operating pressure and supplying steam to the heated members; and a system for recovering condensate from these members at a recovery pressure below the operating pressure; a heat exchanger for each individual soundproof cabin connected to the recirculation system to recover heat and condensate at the recovery pressure before introduction into a boiler.

[0039] A heat exchanger arranged in this way recovers, by transferring it to the cold water flow, the heat from the wet air leaving the ventilation ducts of the soundproof cabins, with the result that the amount of heat and energy lost to the environment is reduced, and the fuel consumed in the boiler is used more efficiently.

[0040] Each heat exchanger is also designed to introduce the condensate recovered from the hot air flow from the cabins back into the supply pipe to the boiler. To achieve greater heat exchange efficiency, the heat exchanger is preferably a counterflow heat exchanger.

[0041] According to a preferred embodiment of the invention, the condensate formed in the heat exchangers of step C) by cooling the hot wet air coming from the corrugating and gluing cabins can be recovered as demineralized water to be supplied to the corrugated cardboard production plant, thereby saving on the amount of water to be supplied to the plant and on treatment costs (demineralization).

[0042] As the water from the condensate is demineralized, it can be made available to the boiler tank or directly to the plant's utilities, saving energy and the ion exchange resins used to demineralize the water itself.

[0043] The steam production and circulation circuit comprises the boiler and a set of pipes for the distribution of steam at the operating pressure to the heated members. The heating steam partly condenses inside the heated members (corrugating rollers, pre-heaters, gluing machine), forming water that must be removed from these members and that can be fed directly back into the boiler.

[0044] Preferably, the recovery system according to the invention further comprises a piping arrangement for recovering condensate at the recovery pressure; at least one condensate collection tank connected to the boiler via piping leading directly to the boiler; at least one pump for feeding condensate into the boiler substantially at the operating pressure.

[0045] These and further advantages of the cardboard production plant and the method of heat and water recovery according to the invention will be highlighted more

clearly in the following description of embodiments with reference to the accompanying figures.

DETAILED DESCRIPTION OF THE INVENTION

[0046] The process for manufacturing corrugated cardboard according to the present invention will now be described in detail with reference to the accompanying Figures 1-2, which are to be considered merely illustrative and not limiting the subject matter of the present patent application.

[0047] Fig. 1 is a schematic longitudinal section view of two corrugating units and the subsequent gluing unit according to the prior art.

[0048] Fig. 2 is a schematic longitudinal section view of a plant in accordance with the invention for manufacturing corrugated cardboard comprising two corrugating units, a gluing unit and a sequence of heat exchangers to which hot air is fed from the outlet of the corrugating and gluing cabins.

[0049] In corrugated cardboard production plants, the raw material is paper that comes from paper mills in the form of very heavy and large reels. These reels are suitably inserted into the corrugating unit, where the progressive and high-speed unwinding of the reels themselves takes place, with subsequent shaping and coupling of the various sheets that make up the finished product type.

[0050] Within each corrugating unit, the continuous sheet is passed through corrugating assemblies, which produce an appropriate and precise shaping on the paper. The final product is the various continuous sheets, corrugated and not, glued together. The process involves heating the continuous sheets by passing them over heated rollers with water vapour.

[0051] The adhesive agent can be starch-based (corn, potato) and in powder form and is the glue that holds the constituent sheets of the corrugated board together, i.e. the cover and corrugated sheets, contributing to the quality of the final product.

[0052] In semi-automatic plants, the starch or similar products are manually taken from containers, weighed and fed into the mixer feed hopper for preparing the glue. In automatic plants, the various products are taken directly from silos and tanks and fed back into the mixer via automatic weighing machines or metering pumps. Sometimes it may be necessary to add some components manually.

[0053] Figure 1 schematically shows a plant for manufacturing corrugated cardboard of the prior art, which comprises a mixer 1 provided for the preparation of an adhesive agent, two corrugation cabins 2, 3 and a gluing cabin 4.

[0054] Starch in powder form is fed via the line 5 to a hopper 6 for feeding into the mixer 1, where it is mixed with a stream of hot water at a temperature suitable for the preparation of the adhesive agent.

[0055] Cold water (T 10-20°C) from the external environment is first subjected to a treatment step 7, and then fed for the most part via the line 8 to the boiler 9 whose task is to generate the steam necessary for heating the equipment in the corrugation cabins 2, 3 and the gluing cabin 4.

[0056] The treatment step 7 is necessary because the water entering the equipment (both boiler and glue preparation mixer) must be free from any deposits, residues or dissolved chemicals, which could cause both problems to the equipment (limescale, corrosion, loss of efficiency, air bubbles, etc.) and to the finished product, in the case of glue. To avoid this, the treatment 7 first involves filtration by means of filters with polypropylene cartridges (melt blown or wire wound) and/or by means of activated carbon filters. Depending on values such as conductivity, pH, hardness and pollutant concentration, the water can then be subjected to reverse osmosis, ion exchangers or correction dosing.

[0057] The remaining cold water from the treatment step 7 is fed via line 10 to the mixer 1 for the preparation of the adhesive agent. Since the temperature required for the preparation of the adhesive agent in the mixer 1 is in the order of 25-45°C, preferably 30-40°C, it is necessary to provide a heating system 11, generally by steam, along the line 10 or, alternatively, inside the mixer 1 in order to heat the water stream to the desired temperature for the preparation of the adhesive agent.

[0058] The adhesive agent prepared in the mixer 1 is dosed via metering pumps (not shown) and sent via line 12 into the feeding trays of the gluers inside the corrugation cabins 2,3 and the gluing cabin 4.

[0059] Each corrugating section 2 comprises unwinders of smooth cardboard reels 13 for feeding to preheating cylinders 14 and then to corrugating rollers 15, from which corrugated sheets are then transferred to the gluing cabin 4.

[0060] In addition, the preheating cylinders 14 receive, via the feed line 16, high temperature steam from the boiler 9 and transfer heat to the sheet of paper from the reel unwinders 13, as the corrugating operation requires high temperatures in the order of 100°C-110°C.

[0061] The corrugating rollers 15 are also heated by high temperature steam from the boiler 9 via the steam feed line 16. A first corrugated sheet 17 is obtained from the first corrugation cabin 2 and transferred to the gluing cabin 4.

[0062] The second corrugation cabin 3 contains practically the same equipment (unwinders 13, pre-heating rollers 14 and corrugating rollers 15) as the first corrugation cabin 3, thus producing a second corrugated sheet 18 which is also transferred to the gluing cabin 4.

[0063] A small amount of adhesive agent from the mixer 1 is fed to the corrugating rollers 15 via the two lines 19,20 and applied to one side of corrugated sheets 17 and 18 leaving the corrugation cabins 2,3.

[0064] The corrugated sheets 17, 18 are fed into the gluing cabin 4 together with a flat sheet of paper 21 from a paper feed reel 22. The sheets 17, 18 and 21 are heated

by preheating cylinders 23, and joined together in a gluing machine 24 to form the desired corrugated cardboard. The quantity of adhesive agent required for gluing is fed to the gluing machine 24 via line 12. The gluing operation requires a temperature comprised between 80 and 100°C.

[0065] The corrugation cabins 2,3 and the gluing cabin 4 are equipped with an extractor fan (not shown in figure 1), which draws in fresh air from outside the cabin to cool the electronics mounted on the machines, the motors of the pre-heating cylinders 14, the corrugating rollers 15 and the gluing machine 24, and to expel the heated air (indicated with arrow C) from the top of the cabins to the outside.

[0066] The fresh air entering the cabins is heated both because of the presence of the preheating cylinders 14, but also because the corrugating rollers 15 operate at high temperature, and because the corrugated sheet coming out of the corrugating rollers 15 is at substantially the same temperature as the corrugating rollers 15.

[0067] The temperature of the hot air C exiting the top of the corrugation sections 2,3 and the gluing section 4 is generally around 40-50°C with a relative humidity of around 50%.

[0068] According to the process of the art shown in figure 1, this hot air C can be used to heat certain rooms (e.g. offices) during the winter months, while the hot air C is expelled directly into the atmosphere during the summer months, since if it were to be released inside the buildings, it would lead to a rise in temperature and humidity that would be unbearable for the operating personnel.

[0069] This expulsion into the environment of hot air at a temperature of 40-50° represents a considerable energy loss, even in the summer months. In order to overcome this drawback, the process for manufacturing corrugated cardboard according to the invention aims to recover heat from this hot air stream to heat the water for the adhesive agent preparation unit. As mentioned above, the temperature required for the preparation of the adhesive agent in the mixer 1 is preferably 30-40°C, and the prior art involves the use of a steam-fed coil or an electric heating element 11 to heat the water stream fed to the mixer 1 at considerable energy expenditure.

[0070] The process of the present invention is illustrated in Figure 2 and makes it possible to avoid unnecessarily wasting the latent heat contained in the flow of hot air C exiting the corrugation 2,3 and gluing cabins 4.

[0071] As mentioned above, the flow of hot air C exiting the upper part of the corrugation cabins 2,3 and gluing cabins 4 has a temperature of around 40-50°C with a relative humidity of around 40-60%. According to the invention, this flow of hot air C is sent to a sequence of heat exchangers 25, within which it encounters the flow of cold water from outside as a counter-current. In fact, after the treatment step 7, a stream of water at room temperature is fed into each heat exchanger 25 via the line 26.

[0072] In the process of the present invention, finned coil heat exchangers with a condensate recovery device are preferably used. At the outlet of each exchanger 25, a stream 27 of heated water having a temperature comprised between 25 and 45°C, preferably 30-40°C, is obtained, which can be recirculated either to the mixer 1 for preparing the adhesive agent, or to the boiler 9 intended for generating the steam used in the plant.

[0073] Preferably between 40 and 60% of the hot water flow from the heat exchangers 25 is recirculated to the mixer 1 via line 28, while the remaining percentage is recirculated to the boiler 9 via line 29.

[0074] In accordance with a preferred embodiment of the present invention, the condensate formed in the heat exchangers 25 for cooling the hot air coming from the corrugation cabins 2,3 and gluing cabins 4 can be recovered as water to be recirculated to the corrugated board production plant, thereby saving on the total amount of water to be supplied to the plant and on treatment costs.

[0075] The water contained in the condensate line 30, being demineralized, can be made available to the boiler tank 9, or fed back into the water supply line 26 to the heat exchangers 25. Alternatively, it can be consumed for the plant's utilities.

[0076] The process according to the present invention is not limited to the particular embodiment described in relation to figure 2, but numerous modifications can be made to it in detail, within the reach of the person skilled in the art, without thereby departing from the scope of the invention itself, as defined in the appended claims.

Claims

1. A process for manufacturing corrugated cardboard including the following steps:

   A) preparing one or more corrugated sheets (17,18) in one or more corrugating units (2,3) by using corrugating rollers (15) heated by steam at a temperature ranging from 100 to 160°C;
   B) gluing of the corrugated sheets (17, 18) with a flat paper sheet (21) by means of an adhesive agent in a gluing machine (24) heated with steam at a temperature of between 100 and 160°C;
   C) feeding the hot air (C) coming from steps A) and B) to a sequence of heat exchangers (25) to heat a stream of cold water coming from the external environment;

   the process being **characterized in that** a stream of water (27) at a temperature between 25 and 45°C is obtained at the outlet of said heat exchangers (25), said stream of water (27) being fed both to a mixer (1), for the preparation of said adhesive agent, and to a boiler (9) used to generate the heating steam of

said steps A) and B).

2. The process according to claim 1, **characterized in that** said adhesive agent is prepared by mixing water coming from said stream (27) with a powder based on vegetable starches selected from corn starches, pea starches, potato starch.

3. The process according to anyone of the previous claims, **characterized in that** the temperature of said stream of water (27) is comprised between 30 and 40°C.

4. The process according to anyone of the previous claims, **characterized in that** the equipment used to carry out said corrugation A) and gluing B) steps is installed inside soundproof cabins.

5. The process according to anyone of the previous claims, **characterized in that** said cold water stream coming from the external environment is subjected to a treatment (7) comprising filtration by means of polypropylene cartridges filters and/or activated carbon filters, and successively reverse osmosis, ion exchangers.

6. The process according to anyone of the previous claims, **characterized in that** the flow of hot air (C) coming from the corrugating units (2,3) and gluing unit (4) has a temperature of 40-50°C with a relative humidity in the range of 40-60%.

7. The process according to anyone of the previous claims, **characterized in that** a percentage between 40 and 60% of said stream of water (27) coming from said heat exchangers (25) is recirculated to the inlet of said mixer (1), while the remaining percentage is recirculated to said boiler (9).

8. The process according to anyone of the previous claims, **characterized in that** said heat exchangers (25) are finned coil heat exchangers equipped with a device for recovering the condensate.

9. The process according to claim 8, **characterized in that** the condensate coming from said heat exchangers (25) is recovered as demineralized water to be recirculated to the plant for manufacturing corrugated cardboard.

10. The process according to anyone of the previous claims, **characterized in that** said gluing step B) is carried out at a temperature between 80°C and 100°C.

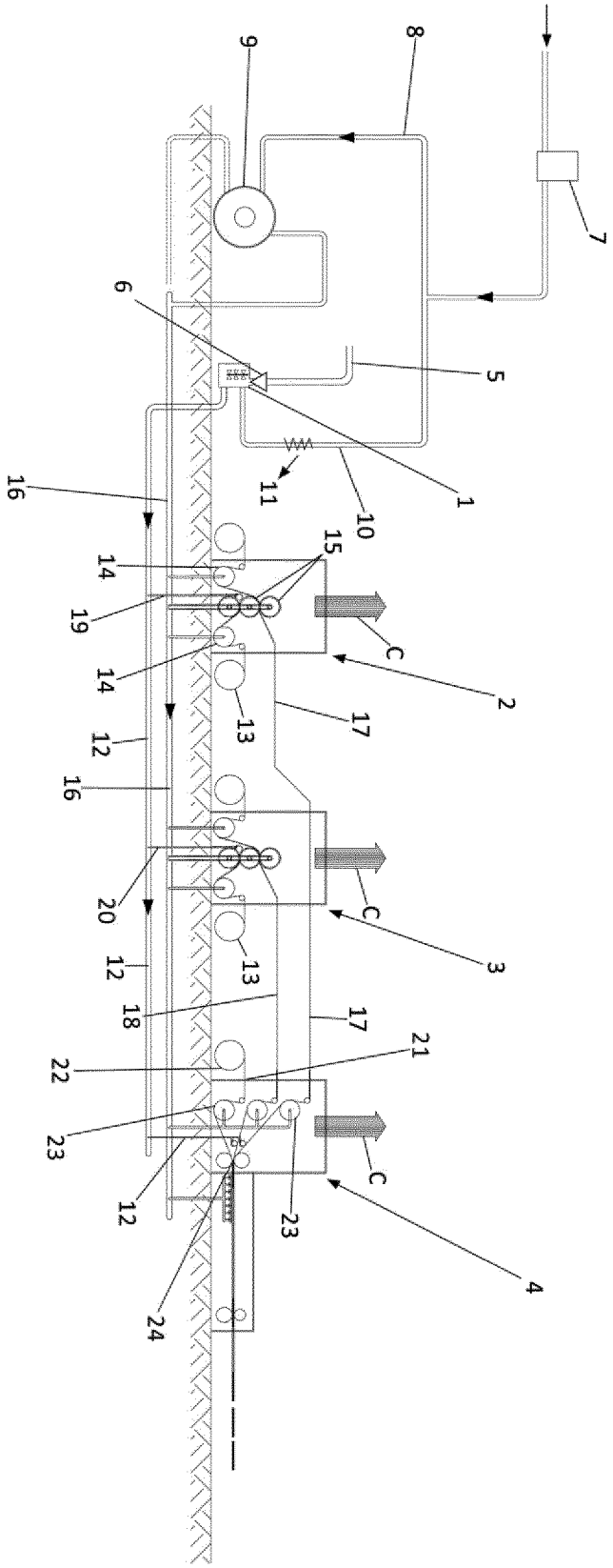

FIG. 1 (PRIOR ART)

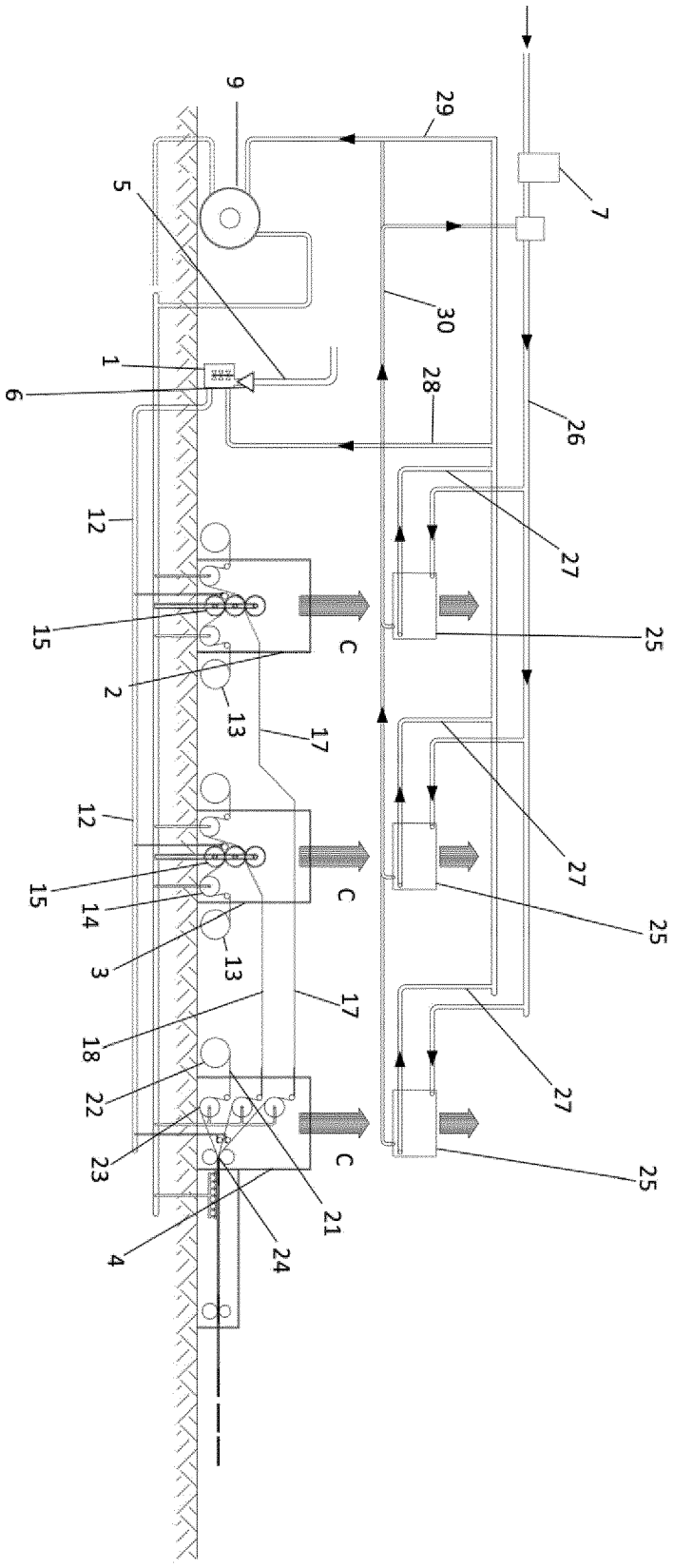
9
29
7
5
30
1
28
6
26
12
27
15
25
C
2
13
17
12
27
15
25
C
14
3
13
17
18
27
22
25
C
23
21
4
24

FIG. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 18 3317

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	IT MI20 110 990 A1 (RIVOLTA GIORGIO) 1 December 2012 (2012-12-01) * paragraphs [0005], [0007], [0009], [0022], [0031] - [0036], [0047], [0051] * * figure 2 *	1-10	INV. B31F1/28 F28B9/08 F28D21/00 F01K17/00 F22D1/18 F28F17/00
A	DE 10 2010 063239 A1 (VOITH PATENT GMBH [DE]) 21 June 2012 (2012-06-21) * paragraphs [0001], [0006] *	1-10	ADD. F01K15/00 F28D7/00
A	DE 10 2011 077795 A1 (VOITH PATENT GMBH [DE]) 20 December 2012 (2012-12-20) * paragraphs [0007], [0011] * * paragraph [0011] *	1-10	
A	DE 10 2010 009741 A1 (FOSBER SPA [IT]) 5 January 2011 (2011-01-05) * paragraphs [0001], [0029], [0036] - [0039] * * figures 1A-2 *	1-10	TECHNICAL FIELDS SEARCHED (IPC)
A	US 8 429 832 B2 (GISSING KLAUS [AT]; PROMITZER WOLFGANG [AT]; ANDRITZ AG MASCHF [AT]) 30 April 2013 (2013-04-30) * column 1, line 44 - column 2, line 3 *	1-10	B31F F28F F22G F01K F28B F28D F22D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 November 2024	Zeiler, Johannes

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 18 3317

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-11-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
IT MI20110990 A1	01-12-2012	---	
DE 102010063239 A1	21-06-2012	NONE	
DE 102011077795 A1	20-12-2012	CN 103748283 A	23-04-2014
		DE 102011077795 A1	20-12-2012
		EP 2721212 A1	23-04-2014
		WO 2012175461 A1	27-12-2012
DE 102010009741 A1	05-01-2011	NONE	
US 8429832 B2	30-04-2013	AT 506077 A4	15-06-2009
		CA 2649284 A1	29-07-2009
		CN 101498111 A	05-08-2009
		EP 2085514 A1	05-08-2009
		ES 2430561 T3	21-11-2013
		PL 2085514 T3	31-12-2013
		RU 2009102189 A	10-08-2010
		US 2009188128 A1	30-07-2009

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- IT 102011901950240 **[0018] [0019]**