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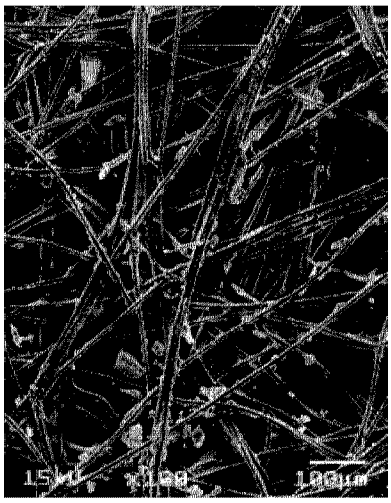
(72) Inventeur/Inventor:
SHEN, SANDRA, CN

(73) Propriétaire/Owner:
SHANGHAI HENGYUAN MACROMOLECULAR MATERIALS CO., LTD., CN

(74) Agent: GOWLING WLG (CANADA) LLP

(54) Titre : SOLUTION DE REGLAGE D'HUMIDITE, ARTICLE DE REGLAGE D'HUMIDITE ENVIRONNEMENTALE ET PROCEDE DE FABRICATION ASSOCIE

(54) Title: HUMIDITY-ADJUSTING SOLUTION, ENVIRONMENTAL HUMIDITY ADJUSTMENT ITEM AND MANUFACTURING METHOD THEREFOR



(57) Abrégé/Abstract:
The present invention provides a humidity-adjusting solution, an environmental humidity adjustment item, and a manufacturing method therefor. The humidity-adjusting solution is used for coated onto a substrate to manufacture the environmental humidity adjustment item for adjusting environmental humidity at 55-68%, and comprises: water and at least one of a citrate, a lactate and a formate; wherein the citrate is at least one of sodium citrate, potassium citrate, and calcium citrate; the lactate is at least one of sodium lactate and potassium lactate; the formate is at least one of sodium formate and potassium formate; the weight percentage of citrate is 33.3~84.2%, the weight percentage of lactate is 33.3~84.2%, and weight percentage of formate is 33.3~84.2%, and the total weight percentage of the citrate, the lactate, and the formate being 33.3 to 84.2%. The manufacturing method comprises the following steps: step 1, preparing the humidity-adjusting solution; and step 2, coating the humidity-adjusting solution onto a substrate.

Abstract

The present invention provides a humidity-adjusting solution, an environmental humidity adjustment item, and a manufacturing method therefor. The humidity-adjusting solution is used for coated onto a substrate to manufacture the environmental humidity adjustment item for adjusting environmental humidity at 55-68%, and comprises: water and at least one of a citrate, a lactate and a formate; wherein the citrate is at least one of sodium citrate, potassium citrate, and calcium citrate; the lactate is at least one of sodium lactate and potassium lactate; the formate is at least one of sodium formate and potassium formate; the weight percentage of citrate is 33.3 ~84.2%, the weight percentage of lactate is 33.3~84.2%, and weight percentage of formate is 33.3~84.2%, and the total weight percentage of the citrate, the lactate, and the formate being 33.3 to 84.2%. The manufacturing method comprises the following steps: step 1, preparing the humidity-adjusting solution; and step 2, coating the humidity-adjusting solution onto a substrate.

Humidity-adjusting solution, environmental humidity adjustment item and manufacturing method therefor

FIELD OF THE INVENTION

The present invention relates specifically to a humidity-adjusting solution, an environmental humidity adjustment item and manufacturing method therefor.

BACKGROUND OF THE INVENTION

"Humidity" is an important factor that affects product packaging and storage life in all walks of life. Each product requires a reasonable humidity range to store. For example, the humidity to store Chinese herbal medicine is about 55%~68%, the environmental humidity below the numerical value will increase the loss of the Chinese herbal medicine and reduce the quality of the Chinese herbal medicine, and the environmental humidity above the numerical value will cause the Chinese herbal medicine to rot, resulting in the deterioration of the Chinese herbal medicine and the failure to use them. The humidity to store some food in dry storage room is about 55%~68%, and the environmental humidity below the numerical value will reduce the quality of the food. The environmental humidity above the numerical value will cause food to rot and even cause food poisoning.

In order to adjust the environmental humidity till within range 55%~68%, the common method is to use gel-type humidity adjustment items to adjust the environmental humidity. When using, the humidity adjust gel needs to be pre-balanced in a constant temperature and humidity chamber, and then the balanced humidity adjust gel is placed into the target environment. The balanced humidity adjust gel can absorb water vapor (absorb moisture) when the target environmental humidity is too high, and release water vapor (release moisture) when the humidity is too low, so that the humidity of the target environment is maintained within a certain range.

However, the above-mentioned humidity adjust gel has the following shortcomings: (1) the humidity adjust accuracy is poor so that the humidity of the target environment may fluctuate in a large range (for example, within the range of ±10%) during use, and it is difficult to maintain a fixed humidity; (2) the production process consumes a lot of energy and produces a lot of waste water, which is not conducive to environmental protection; (3) the user needs to prepare a temperature and humidity chamber for the pre-balance of such a humidity adjust gel so the use cost is high, meanwhile the temperature and humidity chamber is volume-limited and it takes a long time to reach the humidity balance, which makes the gel inconvenient for use.

SUMMARY OF THE INVENTION

The present invention aims the above problems, and provides an environmental humidity adjustment item with cheap raw materials, good humidity adjust

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performance, energy saving, and convenient use and a manufacturing method thereof with simple process. The present invention also provides a humidity-adjusting solution contained in the humidity adjustment item, and the humidity-adjusting solution is also used to be coated to a substrate to manufacture the environmental humidity adjustment item.

The present invention provides a humidity-adjusting solution, used for coated onto a substrate to manufacture an environmental humidity adjustment item used to adjust environmental humidity within 55%~68%, characterized by comprising: water and at least one of citrate, lactate and formate, wherein the citrate is at least one of sodium citrate, potassium citrate and calcium citrate, the lactate is at least one of sodium lactate and potassium lactate; and the formate is at least one of sodium formate and potassium formate, the weight percentage of the citrate is 33.3 ~84.2%, the weight percentage of the lactate is 33.3~84.2%, and the weight percentage of the formate is 33.3~84.2%, the total weight percentage of the citrate, the lactate and the formate is 33.3~84.2%.

The present invention also provides a manufacturing method for an environmental humidity adjustment item used to adjust environmental humidity within 55%~68%, characterized by including the following steps:

step 1, prepare a humidity-adjusting solution,

mix water and at least one of citrate, lactate and formate at not less than 30°C to prepare a humidity-adjusting solution;

step 2, coat the humidity-adjusting solution onto a substrate;

coat the substrate with the humidity-adjusting solution of a coating speed of 1~15m/s at a predestined temperature no less than 30°C, and the humidity-adjusting solution loaded onto the substrate is 0.54~0.74 g per cubic centimeter,

wherein the citrate is at least one of sodium citrate, potassium citrate and calcium citrate,

the lactate is at least one of sodium lactate and potassium lactate; and

the formate is at least one of sodium formate and potassium formate,

the weight percentage of the citrate is 33.3 ~84.2%, the weight percentage of the lactate is 33.3~84.2%, and the weight percentage of the formate is 33.3~84.2%,

the total weight percentage of the citrate, the lactate and the formate is 33.3~84.2%.

The manufacturing method provided by the present invention could be further characterized by that, wherein the predestined temperature in step 2 is 45~55°C.

The manufacturing method provided by the present invention could be further characterized by that, wherein the humidity-adjusting solution includes one of the citrate, the citrate is sodium citrate, the weight percentage of the citrate in the humidity-adjusting solution is 33.3 ~84.2%.

The manufacturing method provided by the present invention could be further characterized by that, wherein the humidity-adjusting solution includes one of the lactate, the lactate is sodium lactate, the weight percentage of the lactate in the humidity-adjusting solution is 33.3 ~84.2%.

The manufacturing method provided by the present invention could be further

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characterized by that, wherein the humidity-adjusting solution includes formate and anyone of citrate and lactate, the weight percentage of the formate in the humidity-adjusting solution is 25.0 ~52.6%, the weight percentage of the citrate in the humidity-adjusting solution is 8.3~31.6%, the weight percentage of the lactate in the humidity-adjusting solution is 8.3~31.6%.

The manufacturing method provided by the present invention could be further characterized by that, wherein the weight percentage of the formate in the humidity-adjusting solution is 32.7 ~41.0%, the weight percentage of the citrate in the humidity-adjusting solution is 12~20%, the weight percentage of the lactate in the humidity-adjusting solution is 12~20%.

The manufacturing method provided by the present invention could be further characterized by that, wherein the humidity-adjusting solution includes formate, citrate and lactate, the weight percentage of the formate in the humidity-adjusting solution is 25.0~52.6%, the weight percentage of the citrate in the humidity-adjusting solution is 3~15.3%, the weight percentage of the lactate in the humidity-adjusting solution is 5~25.3%, the total weight percentage of the citrate and the lactate in the humidity-adjusting solution is 8.3 ~31.6%.

The manufacturing method provided by the present invention could further comprise: step 3, cut the substrate, cut the substrate into a predetermined size.

The manufacturing method provided by the present invention could further comprise: step 4, package, pack the substrate loaded with the humidity-adjusting solution with a package bag.

Also the present invention provides an environmental humidity adjustment item used to adjust environmental humidity within 55%~68%, characterized by being manufactured by anyone of above-mentioned manufacturing methods.

THE EFFECT OF THE PRESENT INVENTION

According to the humidity-adjusting solution and environmental humidity adjustment item of the present invention, the humidity-adjusting solution is composed of water and at least one of citrate, lactate and formate, wherein the citrate is at least one of sodium citrate, potassium citrate and calcium citrate; lactate is at least one of sodium lactate and potassium lactate; the formate is at least one of sodium formate and potassium formate; and the weight percentage of citrate is 33.3 ~84.2%, the weight percentage of lactate is 33.3~84.2%, and weight percentage of formate is 33.3~84.2%. Therefore, the humidity-adjusting solution of the present invention can be used to manufacture environmental humidity adjustment item. The environmental humidity adjustment item can adjust and maintain the environmental humidity within a certain humidity in a range of 55-68%, and the humidity does not fluctuate during the maintenance process. On the other hand, the environmental humidity adjustment item can adjust the environmental humidity directly after being directly placed in the target environment without being pre-balanced, so users do not need to prepare the humidity chamber, which makes it is convenient and fast for use with low cost.

In addition, in the manufacturing method of the environmental humidity

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adjustment item of the present invention, since the temperature is not lower than 40°C during the preparation and coating process of the humidity-adjusting solution, the solute is easy to dissolve and the solution is easy to coat. Moreover, there is a temperature difference between the coating process temperature and room temperature, once the coating process is completed and the item is placed to room temperature, the solute solubility of the humidity-adjusting solution loaded onto the substrate will change, so that the solution changes from an unsaturated state to a saturated state and then produces fine crystals, making the humidity control item obtain a higher ability of moisture absorption and release, and obtain a better humidity control performance. Furthermore, the manufacturing method has the advantages of simple steps, low energy consumption and low cost.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

<Embodiment 1>

A manufacturing method for an environmental humidity adjustment item used to adjust environmental humidity within 55%~68%, including the following steps:

Step 1, prepare a humidity-adjusting solution.

Mix citrate and water at not less than 30°C to prepare a humidity-adjusting solution.

Step 2, coat the humidity-adjusting solution onto a substrate.

Coat the substrate with the humidity-adjusting solution of a coating speed of 1~15m/s at a temperature no less than 30°C, and the humidity-adjusting solution loaded onto the substrate is 0.54~0.74 g per cubic centimeter.

Step 3, cut the substrate.

Cut the substrate into a predetermined size. In this embodiment, the thickness of the substrate is greater than 1 mm. The predetermined size can be set according to the needs of users, and can be from 1 cm×1 cm to 100 cm×100 cm.

The substrate has a certain water absorption performance, and the water absorption of the substrate is not less than 0.5 grams per cubic centimeter. The material of the substrate can be any one of paper material, cotton cloth, chemical fiber material, non-woven fabric, felt, porous plastic, and mineral substrate. In this embodiment 1, the substrate is a kind of paper materials, cotton wood pulp paper. The water absorption performance of the cotton wood pulp paper is not less than 0.8 g per cubic centimeter, and the water retention performance is not less than 1.2 g per cubic centimeter. The thickness of the cotton wood pulp paper is 2mm to facilitate cutting operation.

The citrate is sodium citrate, the weight percentage of sodium citrate in the solution is 33.3% ~84.2%.

The purity of the sodium citrate is not less than 99.9%. The water is deionized water.

<Embodiment 2>

A manufacturing method for an environmental humidity adjustment item used to

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adjust environmental humidity within 55%~68%, including the following steps:

Step 1, prepare a humidity-adjusting solution.

Mix citrate, formate and water at not less than 30°C to prepare a humidity-adjusting solution.

Step 2, coat the humidity-adjusting solution onto a substrate.

Coat the substrate with the humidity-adjusting solution of a coating speed of 1~5m/s at 30°C, and the humidity-adjusting solution loaded onto the substrate is 0.74 g per cubic centimeter.

Step 3, cut the substrate.

Cut the substrate into a predetermined size. In this embodiment, the thickness of the substrate is 0.1~1 mm. The predetermined size can be set according to the needs of users, and can be from 2 cm×2 cm to 50 cm×50 cm.

The citrate is sodium citrate, the formate is sodium formate.

The weight percentage of the sodium formate in the humidity-adjusting solution is 25%~52.6%.

The weight percentage of the sodium citrate in the humidity-adjusting solution is 8.3%~31.6%.

The purity of the sodium formate and the sodium citrate is not less than 99.9%. The water is deionized water.

When the weight percentage of the sodium formate and the sodium citrate are greater than the above-mentioned percentage ranges, crystallization is easy to occur in the solution, which needs high temperature to re-dissolve, resulting in high loss and making quality of the solution unstable. When the weight percentage of the sodium formate and the sodium citrate are less than the above-mentioned percentage ranges, the humidity-adjusting substance in the humidity-controlling solution loaded on the substrate will decrease, leading the humidity-adjusting performance decreases.

<Embodiment 3>

A manufacturing method for an environmental humidity adjustment item used to adjust environmental humidity within 55%~68%, including the following steps:

Step 1, prepare a humidity-adjusting solution.

Mix lactate and water at 40°C to prepare a humidity-adjusting solution.

Step 2, coat the humidity-adjusting solution onto a substrate.

Coat the substrate with the humidity-adjusting solution of a coating speed of 5~10m/s at 40°C, the humidity-adjusting solution loaded onto the substrate is 0.64 g per cubic centimeter.

Step 3, cut the substrate.

Cut the substrate into a predetermined size. In this embodiment, the thickness of the substrate is 0.1~1 mm. The predetermined size can be set according to the needs of users, and can be from 2 cm×2 cm to 50 cm×50 cm.

Step 4, package.

Pack the substrate loaded with the humidity-adjusting solution with a package bag.

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In this embodiment 3, the lactate is sodium lactate, the weight percentage of sodium lactate in the humidity-adjusting solution is 33.3% ~84.2%.

The purity of the sodium lactate is not less than 99.9%. The water is deionized water.

The substrate loaded with the humidity-adjusting solution is held in the package bag. The package bag is made of thin film materials, which are permeable to water vapor but not to liquid solutions, such as non-woven fabrics, composite plastic bags, paper-plastic composite bags, and cloth bags. In this embodiment 3, the material of the package bag is non-woven fabric.

<Embodiment 4>

A manufacturing method for an environmental humidity adjustment item used to adjust environmental humidity within 55%~68%, including the following steps:

Step 1, prepare a humidity-adjusting solution.

Mix citrate, formate and water at 45°C to prepare a humidity-adjusting solution.

Step 2, coat the humidity-adjusting solution onto a substrate.

Coat the substrate with the humidity-adjusting solution of a coating speed of 10~15m/s at 35°C, and the humidity-adjusting solution loaded onto the substrate is 0.54 g per cubic centimeter.

Step 3, cut the substrate.

Cut the substrate into a predetermined size. In this embodiment, the thickness of the substrate is 0.1~1 mm. The predetermined size can be set according to the needs of users, and can be from 2 cm×2 cm to 50 cm×50 cm.

The citrate is sodium citrate, the formate is sodium formate.

The weight percentage of the sodium formate in the humidity-adjusting solution is 32.7%~41.0%.

The weight percentage of the sodium citrate in the humidity-adjusting solution is 12%~20%.

The purity of the sodium formate and the sodium citrate is not less than 99.9%. The water is deionized water.

<Embodiment 5>

A manufacturing method for an environmental humidity adjustment item, in which the specific steps are the same as the embodiment 1.

Wherein, in step one, lactate, formate and water are mixed at 30°C to prepare a humidity-adjusting solution.

The lactate is potassium lactate and the formate is sodium formate.

The weight percentage of the sodium formate is 25.0%~52.6%.

The weight percentage of the sodium citrate is 8.3%~31.6%.

The purity of sodium formate and potassium lactate is not less than 99.9%. The water is deionized water.

<Embodiment 6>

A manufacturing method for an environmental humidity adjustment item, in

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which the specific steps are the same as the embodiment 1.

Wherein, in step one, lactate, formate and water are mixed at 30°C to prepare a humidity-adjusting solution.

The lactate is sodium lactate and the formate is potassium formate.

The weight percentage of the potassium formate is 25.0%~52.6%.

The weight percentage of the sodium lactate is 8.3%~31.6%.

The purity of sodium lactate and potassium formate is not less than 99.9%. The water is deionized water.

<Embodiment 7>

A manufacturing method for an environmental humidity adjustment item, in which the specific steps are the same as the embodiment 1.

Wherein, in step one, citrate, formate and water are mixed at no less than 40°C to prepare a humidity-adjusting solution.

The citrate is potassium citrate, the lactate is sodium lactate, and the formate is potassium formate.

The weight percentage of potassium formate is 25.0%~52.6%.

The weight percentage of potassium citrate is 3%~15.3 %.

The weight percentage of sodium lactate is 5%~25.3 %.

The total weight percentage of citrate and formate is 8.3%~31.6%.

The purity of the potassium citrate, sodium lactate and potassium formate is not less than 99.9%. The water is deionized water.

<Embodiment 8>

A manufacturing method for an environmental humidity adjustment item, in which the specific steps are the same as the embodiment 1.

Wherein, in step one, formate and water are mixed at no less than 50°C to prepare a humidity-adjusting solution.

The formate is potassium formate.

The weight percentage of potassium formate is 33.3%~84.2 %.

The purity of the potassium formate is not less than 99.9%. The water is deionized water.

Take the embodiment 4 as an example, the weight percentages of NaCl, NH_4Cl and water for adjusting different humidity in the humidity-adjusting solution are shown in Table 1 below:

Table 1. The weight percentages of NaCl, NH_4Cl and water for adjusting different humidity in the humidity-adjusting solution of embodiment 4

Adjusting humidity (%)	Sodium citrate (%)	Sodium formate(%)	H_2O (%)
68	32.7	18.7	48.6
63	35	20	45
60	40	12	48
55	41	12	47

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Take the environmental humidity adjustment item in the embodiment 4 with a size of 0.42m^2, a thickness of 0.3 cm and a weight of 1 kg, and adjust the environmental humidity of an 1 cubic meter airtight space (without external air exchange) with an initial humidity of 10%~90% at 25°C. The environmental humidity of the space can be adjusted to a certain humidity within 55~68% with a long-time adjusting effective. If the air in the space is exchanged with the outside air with a humidity range of 30% for a long time, the effective time of humidity adjusting is 1 month.

<Embodiment 9>

It is found by inventors that the humidity-adjusting solution composed of at least one of citrate, lactate and formate and water in the above embodiments is an unsaturated solution at a certain temperature, and the unsaturated solution performs well properties of fluidity. In addition, the solubility of solutes such as citrate, lactate and formate used in the above-mentioned embodiments at different temperatures differs obviously. Therefore, in the process of coating the humidity-adjusting solution to the substrate, if the solution is kept at the certain temperature, the coating process can proceed smoothly; further, after coating on the substrate, if the solution is gradually reduced till room temperature (20°C~25°C), the following phenomena will occur: as the temperature decreases, the solubility of the solute in the solution decreases, making the solution change from unsaturated to saturated, which in turn makes the solute in the solution (such as salts) form fine crystals, and the saturated solution containing fine crystals has a capacity of moisture absorption and release higher than other solutions, so that the environmental humidity adjustment item has a good humidity adjusting performance, and can quickly adjust and maintain the environmental humidity to a predetermined humidity.

Therefore, in the manufacturing methods of environmental humidity adjustment items of the above embodiment 1 to 8, the preparation in step 1 and coating process in step 2 are both performed under the condition of not lower than 40°C. This embodiment is an experiment to investigate the optimal temperature of the preparation and coating on the basis of above embodiments. The specific operation steps are the same as embodiment 1. At the same time, the formula of the humidity-adjusting solution is the same as that in Table 1 for adjusting humidity 60%, that is, the humidity-adjusting solution of this embodiment is composed 40% weight percentage of sodium formate, 12% weight percentage of sodium citrate, and 48% weight percentage of water.

Also it is found by inventors that sodium formate and sodium citrate are easier to dissolve between 40°C and 85°C, specifically: if it is lower than 40°C, sodium formate and sodium citrate cannot be completely dissolved in the liquid solvent, and the obtained humidity-adjusting solution contains fine particles and seems slightly turbid. If the temperature is higher than 85°C, the solvent (i.e., water) will partly volatilize, resulting in a composition ratio change of the humidity-conditioning liquid obtained after dissolution. According to Table 1, such composition changes in the

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humidity-adjusting solution will lead to adjusting humidity (which is, target humidity of adjusting), so that the environmental humidity adjustment item cannot maintain the target environment near the adjusting humidity.

In order to avoid such problems, the step 1 of this embodiment adopts the method of heating and dissolving between 40°C and 85°C, specifically: heating the water to 40°C, adding solids and then stirring while heating until the temperature reaches 85°C, keep the temperature and stir until all the solids are dissolved and the solution become uniform and transparent, and the humidity-adjusting solution is obtained. Then, the temperature of the humidity-adjusting solution is adjusted to a predetermined temperature, and the environmental temperature of the coating equipment is maintained at the predetermined temperature to perform the coating operation of step 2.

For step 2, this embodiment investigate the difference in the weight of the substrate before and after coating (i.e., the weight reduction) under the condition that the coating temperature is a predetermined temperature and the coating action lasts for a predetermined time. The specific results are shown in Table 2 below. In Table 2, 40°C, 45°C, 50°C, 55°C, 65°C, 75°C, 80°C, 85°C, 90°C are the predetermined temperatures for the coating process, 10min, 30min, 60min, 80min, 100min are the predetermined time of the coating process operation lasts, and the percentage values in the table are the percentage of weight reduction of each coated substrate after it is lowered to room temperature (20℃~25℃).

Table 2. The relationship between solvent volatilization (%) and coating time at different predetermined temperatures

	40℃	45℃	50℃	55℃	60℃	65℃	75℃	80℃	85℃	90℃
10min	0	0	0	0	0	0	0	0.21%	0.53%	1.2%
30min	0	0	0	0	0	0	0.1%	0.73%	1.7%	4.2%
60min	0	0	0	0	0	0.10%	0.19%	1.58%	3.2%	7.9%
80min	0	0	0	0	0.09%	0.15%	0.26%	2.06%	4.8%	9.8%
100min	0	0	0	0	0.12%	0.23%	0.36%	3.1%	6.0%	11.8%

Due to the differences in the solubility of different solutes, when the solvent volatilization exceeds 5%, the weight percentage of the solute in the obtained saturated solution will change. If the weight percentage is changed, the environmental humidity adjustment item cannot adjust the environmental humidity within ±2% of the target humidity, and cannot achieve the humidity adjustment requirements.

According to the solvent volatilization data shown in Table 2, when the predetermined temperature of the coating process is 85°C, the solvent volatilization exceeds 5%, and the humidity control article obtained in this way cannot meet the demand. Therefore, the predetermined temperature for coating should not exceed 80°C.

Further, the inventors also investigated the optimal range of the predetermined

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temperature for coating based on the actual conditions of the coating equipment of the prior art.

Specifically, the inventors tried two processes, roll coating and dip coating, to coat cotton wood pulp paper substrates of different thicknesses with the humidity-adjusting solution of the above embodiments, and found that: for substrates of different sizes, under the premise of uniform coating, the maximum time required for roller coating and dip coating are generally within 80 minutes. Therefore, the coating process can generally be completed within 80 minutes. According to Table 2, when the predetermined temperature of the coating process is 60°C, the volatilization of the solvent within 80 minutes is almost zero. In addition, when the temperature difference between the predetermined temperature of the coating process and the room temperature is large, maintaining the predetermined temperature requires more energy, so the predetermined temperature should not be too high considering with energy consumption. Therefore, the lower limit of the optimum range of the predetermined temperature in the coating process is 55°C.

In addition, when the predetermined temperature is 40°, the humidity-adjusting solution shows a high viscosity and is likely to crystallize during the coating process. It is difficult for the existing roll coating equipment or dip coating equipment to ensure uniform coating in this situation. When the predetermined temperature rises to 45°C, the humidity-conditioning liquid is transparent and the viscosity decreases, which makes the roll coating equipment or dip coating equipment can achieve uniform coating, so the lower limit of the optimal range of the predetermined temperature is 45°C.

In summary, the optimum temperature range for the coating operation obtained in this embodiment is 45°C to 55°C.

Fig. 1 is an electron microscope photograph of the environmental humidity adjustment item according to embodiment 8 of the present invention. Specifically, Fig. 1 selects the environmental humidity adjustment item prepared under the conditions of the predetermined temperature of 50° C and the coating time of 80 minutes in the coating process of this embodiment.

As shown in Fig. 1, in the environmental humidity adjustment item obtained by the manufacturing method of this embodiment, the humidity-adjusting solution forms fine crystals inside the substrate, and these crystals have relatively uniform particle size and relatively uniform distribution. At the same time, these crystals attach onto the fibers inside the substrate, so they are not easy to fall off.

Fig. 2 is a humidity adjustment effect diagram of the environmental humidity adjustment item according to the embodiment 8 of the present invention. In Fig. 2, the abscissa is time (day), and the ordinate is temperature (℃) and humidity (%).

Cut the environmental humidity adjustment item corresponding to Fig. 1 into small pieces, take 10g and put into a closed container (the volume of the container is about 2L), and use a hygrometer to monitor and record the humidity in the container in real time. The result is shown in Fig. 2.

It can be seen from Fig. 2 that the initial humidity in the container is about 54%. After putting the environmental humidity adjustment item of this embodiment (the

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putting time is T1), the humidity rises rapidly and reaches 60% in a very short time. Subsequently, it has been maintained at 60% for a long time and the humidity hardly fluctuates during the process. Open the container halfway (the opening time point is T2) to make the internal air and the air in the outside environment circulated completely for more than one day, and then close the container (the closing time point is T3), it can be seen that the container remains open for the time in which the humidity continues to fluctuate due to external influences, and after closing the container, the environmental humidity adjustment item in the container continue to effect, leading the humidity in the container returns to 60%.

It can be seen that the environmental humidity adjustment item of this embodiment can quickly adjust the environmental humidity to the target humidity, and can maintain the humidity for a long time without humidity fluctuations during the process. At the same time, even if the humidity is disturbed in the process of maintaining, once the disturbance is removed, the humidity control article of this embodiment can adjust the humidity to the target humidity again and continue to maintain the humidity.

The Effect of the embodiments

According to the humidity-adjusting solution and environmental humidity adjustment item of the present embodiments, the humidity-adjusting solution is composed of water and at least one of citrate, lactate and formate, wherein the citrate is at least one of sodium citrate, potassium citrate and calcium citrate; lactate is at least one of sodium lactate and potassium lactate; the formate is at least one of sodium formate and potassium formate; and the mass fraction of citrate is 33.3 ~84.2%, the range of mass fraction of lactate is 33.3~84.2%, and the range of mass fraction of formate is 33.3~84.2%. Therefore, the humidity-adjusting solution of the present embodiments can be used to manufacture environmental humidity adjustment item. The environmental humidity adjustment item can adjust and maintain the environmental humidity within a certain humidity in a range of 55-68%, and the humidity does not fluctuate during the maintenance process. At the same time, the environmental humidity adjustment item of this embodiment still has the ability to maintain humidity after being disturbed, which shows well stability. On the other hand, the environmental humidity adjustment item can adjust the environmental humidity directly after being directly placed in the target environment without being pre-balanced, so users do not need to prepare the humidity chamber, which makes it is convenient and fast for use with low cost.

Moreover, the humidity-adjusting solution in the environmental humidity adjustment item of this embodiment uses water and any one of citrate, lactate and formate, so the solution composed of these ingredients is not only low in cost, but also safe for the manufacture workers, environment and objects to be stored. Moreover, the environmental humidity adjustment items of these embodiment are only composed of salt, water, and paper base material, so they are friendly to the natural environment after being discarded, and can be naturally decomposed without causing secondary pollution.

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In addition, in the manufacturing method for the environmental humidity adjustment items of these embodiment, since the humidity-adjusting solution is prepared at 40°C to 85°C, the solute is easily dissolved and the preparation operation is easy to complete; because the humidity-adjusting solution is coated at a predetermined temperature of 45℃~55℃, so the solution is easy to coat for the low viscosity; further, because the solute solubility of the solute in the humidity-adjusting solution changes after the coating is completed, so the humidity-adjusting solution changes from the unsaturated state to the saturated state, which causes the fineness crystallization and makes the environmental humidity adjustment item perform higher capacity of moisture absorption and release, and has well humidity control performance.

The foregoing embodiments are preferred cases of the present invention and is not used to limit the scope of protection of the present invention.

In the embodiments, the substrate is a kind of paper materials, cotton wood pulp paper. This kind of substrate is mainly made of wood pulp, cotton pulp, etc., so it has strong water retention and can absorb more liquid. In the present invention, the substrate can also be made of other similar materials, such as cotton cloth, chemical fiber materials, non-woven fabrics, felt, porous plastics, mineral substrates and the like.

In the embodiment, the package bag is made of a thin-walled material that is permeable to water vapor but not permeable to liquid solutions. In the present invention, small holes can also be provided on the package bag, and the speed of humidity adjustment can be changed by adjusting the number of small holes (for example, a large number of small holes can allow the environmental humidity adjustment items to contact the air in the environment faster, leading a quicker humidity adjustment). Furthermore, other package ways can also be used in the present invention, for example, a protective film made of breathable material could be covered on the surface of the substrate coated with the humidity-adjusting solution and lowered to room temperature, so that the humidity adjustment item is of a larger size, which users can cut arbitrarily according to their needs, being more convenient to use.

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What is claimed is:

1. A humidity-adjusting solution, used for coated onto a substrate to manufacture an environmental humidity adjustment item used to adjust environmental humidity within 55% - 68%, comprising:

water and at least one of citrate, lactate and formate,

wherein said citrate is at least one of sodium citrate, potassium citrate and calcium citrate,

said lactate is at least one of sodium lactate and potassium lactate; and

said formate is at least one of sodium formate and potassium formate,

the weight percentage of said at least one of citrate, lactate and formate in said humidity-adjusting solution is 33.3 - 84.2%,

the total weight percentage of said at least one of citrate, lactate and formate in said humidity-adjusting solution is 33.3 - 84.2%.

2. A manufacturing method for an environmental humidity adjustment item used to adjust environmental humidity within 55%-68%, the method comprising:

mixing water and at least one of citrate, lactate and formate at not less than 30°C to prepare a humidity-adjusting solution;

coating said substrate with said humidity-adjusting solution with a coating speed of 1 - 15m/s at a predestined temperature no less than 30°C, wherein said humidity-adjusting solution loaded onto said substrate is 0.54 - 0.74 g per cubic centimeter,

wherein said citrate is at least one of sodium citrate, potassium citrate and calcium citrate,

said lactate is at least one of sodium lactate and potassium lactate;

said formate is at least one of sodium formate and potassium formate,

the weight percentage of said at least one of citrate, lactate and formate in said humidity-adjusting solution is 33.3 - 84.2%

the total weight percentage of said at least one of citrate, lactate and formate in

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said humidity-adjusting solution is 33.3 - 84.2%.

3. The manufacturing method according to claim 2, characterized by that:

wherein said predestined temperature in step 2 is 45 - 55°C.

4. The manufacturing method according to claim 2, characterized by that:

wherein said humidity-adjusting solution includes one of said citrate,

said citrate is sodium citrate,

the weight percentage of said citrate in said humidity-adjusting solution is 33.3 - 84.2%.

5. The manufacturing method according to claim 2, characterized by that:

wherein said humidity-adjusting solution includes one of said lactate,

said lactate is sodium lactate,

the weight percentage of said lactate in said humidity-adjusting solution is 33.3 - 84.2%.

6. The manufacturing method according to claim 2, characterized by that:

wherein said humidity-adjusting solution includes formate and any one of citrate and lactate,

the weight percentage of said formate in said humidity-adjusting solution is 25.0 - 52.6%,

the weight percentage of said any one of citrate and lactate in said humidity-adjusting solution is 8.3 - 31.6%.

7. The manufacturing method according to claim 6, characterized by that:

wherein the weight percentage of said formate in said humidity-adjusting solution is 32.7 - 41.0%,

the weight percentage of said any one of citrate and lactate in said humidity-adjusting solution is 12 - 20%.

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8. The manufacturing method according to claim 2, characterized by that:

wherein said humidity-adjusting solution includes formate, citrate and lactate,

the weight percentage of said formate in said humidity-adjusting solution is 25.0 - 52.6%,

the weight percentage of said citrate in said humidity-adjusting solution is 3 - 15.3%,

the weight percentage of said lactate in said humidity-adjusting solution is 5 - 25.3%,

the total weight percentage of said citrate and said lactate in said humidity-adjusting solution is 8.3 - 31.6%.

9. The manufacturing method according to claim 2, characterized by further comprising:

cutting said substrate into a predetermined size.

10. The manufacturing method according to claim 2, characterized by further comprising:

packing the substrate loaded with the humidity-adjusting solution with a package bag.

11. An environmental humidity adjustment item used to adjust environmental humidity within 55% - 68%, characterized by being manufactured by a manufacturing method according any one of claims 2-10.

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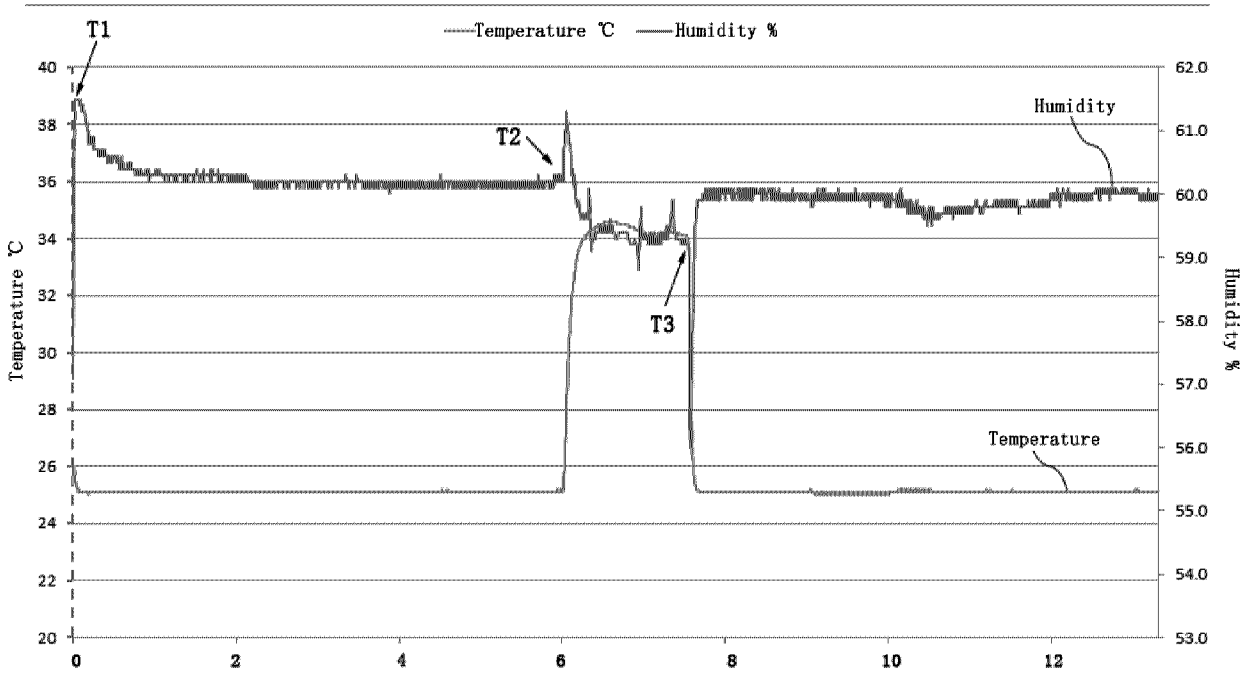

Fig. 1

Fig. 2

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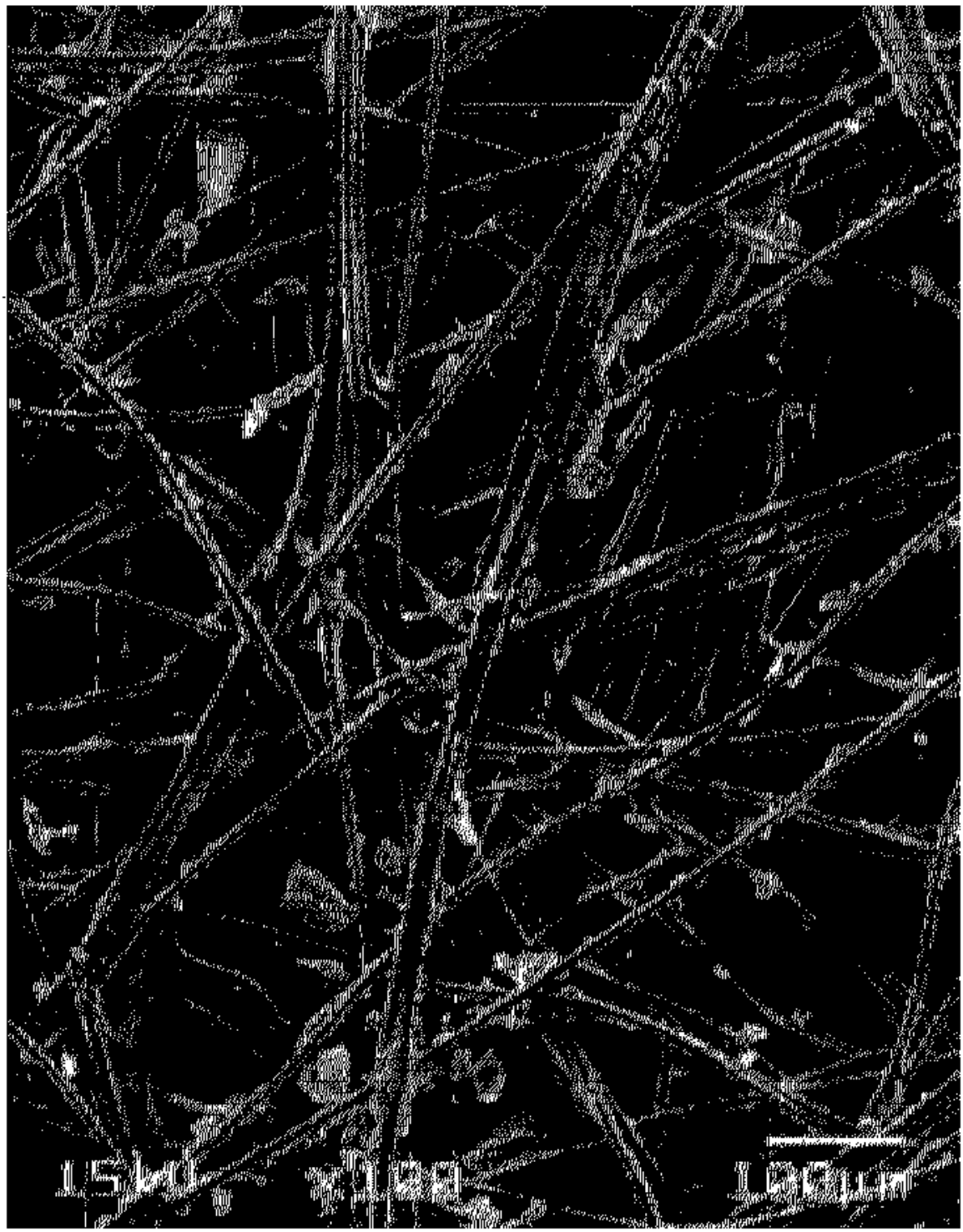
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