Study on Improving the Quality of Adhesive Interlining using Urea Resin

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ABSTRACT

Background

In order to increase the adhesive strength of the adhesive interlining, it is necessary to make a good adhesive and use it. In the process of the production of adhesive interlining with DR501 as the main raw material, the adhesive hardened rapidly, which prevented frequent screening and prevented the quality of the produced adhesive interlining. In this paper, an emulsion-type urea-formaldehyde water-soluble liquid resin was prepared for the production of adhesive interlining, and a new adhesive interlining production process was established using it. The addition condensation reactant was introduced into the emulsion phase during the initial condensation of urea-formaldehyde using an organic catalyst to obtain a urea-formaldehyde emulsion resin with good adhesion close to the properties of an acrylic resin emulsion (DR501). The new emulsion-type urea-formaldehyde aqueous resin solution was prepared by adding urotropin to improve the water resistance and adhesion strength of the adhesive significantly after the addition condensation reaction was completed. It also developed a formula for adhesive core resin paste with emulsion resin as a feedstock, thus making full use of existing production processes and equipment, raising production efficiency and operating rate of equipment and improving the quality of products. In this regard, the paper adjusted the viscosity of the resin paste to 120 Pa•s, further improved the viscosity of the resin paste so as to better capture and fix the polyester powder, and developed a rational formula for doubling the water resistance, brittleness and adhesive strength of urea resin.

Keywords: Adhesive Interlinings, Urea Resin, Adhesive, Textile

INTRODUCTION

Recently, it has become popular worldwide to produce plastic powder-sprayed adhesive interlining by the method of adhesives(1).

After the acrylic resin emulsion resin adhesive was prepared by the process and method of powder-sprayed adhesive interlining production, the resin adhesive was dotted at regular intervals on the substrate through a cylindrical screen and the polyester resin powder was sprayed over the surface. Then, through a vibrating screen and a vacuum cleaner, the resin powder sprayed on the unpainted part of the resin adhesive is recycled and the powder that falls on the resin adhesive is adhered to the resin adhesive, so it is heated and melted to the substrate through heat treatment to produce an adhesive interlining.

However, resin adhesives prepared from acrylic resin emulsions DR501 and DR402 were gelatinized and cured at room temperature after a certain period of time, during the process of production, by filling the fine pores of cylindrical screens to stop production and frequent washing of the screens with organic solvents, as well as their ability to trap and fix the resin powder due to the short duration of retention, resulting in poor quality of the adhesive interlining produced and very low adhesive strength.

Therefore, we developed new adhesives to improve the quality of products and put their production on a

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normal footing and applied them to various fields of the interlining cloth production and textile industry, thus making it possible to diversify textile products, reduce the cost of various kinds of fabrics including interlining cloth, raise their quality and put production on a normal basis.

METHOD

Research direction

Worldwide, the production of adhesive interlinings uses materials such as polyethylene-vinyl acetate copolymers, polyvinyl, polyamide, acrylic, and polyester phenolic resins as materials for plastic adhesives according to their production processes, equipment, type of adhesive interlinings, technological conditions, and properties(2).

In this paper, we first selected a thermosetting urea resin material based on urea and formaldehyde and developed a new emulsion-type urea-formaldehyde aqueous liquid resin with better adhesion performance compared to the conventional material (DR501).

The urea-formaldehyde resin known so far is divided into molding, adhesive and foaming media according to the pH of the medium and prepared via an initial condensation step.

However, the above materials are additional condensation reactants produced in the presence of inorganic catalysts and viscous liquids or polymeric compounds prepared by vacuum dehydration process in the presence of organic formaldehyde. It is also unsuitable as a material for the production of adhesive interlinings for clothing because of its poor water resistance, brittleness, moisture absorption and low adhesion strength.

Hence, we used an organic catalyst to derive the adduct condensation reactant in the emulsion phase during the formation of urea-formaldehyde primary condensate to obtain a urea-formaldehyde emulsion resin with good adhesion close to the properties of an acrylic resin emulsion (DR501).

Next, since the developed emulsion resin did not improve the moisture resistance after curing, we prepared a new emulsion-type urea-formaldehyde aqueous resin that was developed by the addition of urotropin after the completion of the addition condensation reaction, which significantly improved the water resistance, adhesion strength, and brittleness of the developed urea-formaldehyde emulsion resin.

It also confirmed the formula for adhesive core resin adhesive with emulsion resin as a feedstock to raise the production efficiency and operation rate of equipment while using existing production processes and equipment and improve the quality of products much more than those of raw materials.

In this regard, we developed a rational formula for doubling the water resistance, brittleness and adhesive strength of urea resin by adjusting the viscosity of the resin adhesive to 120 Pa·s, increasing the viscosity of the resin adhesive so as to better capture and fix the polyester powder.

Theoretical basis of adhesive manufacturing

In the reaction of urea with formaldehyde, methylation (addition) and methylation (condensation) reactions are competing repetitions to grow urea resin molecules(3, 4).

Since this reaction is an acid-base catalyzed reaction, the reaction rate depends on the pH of the medium.

$$CO^{-NH_2}_{-NH_2} + CH_2O \overset{H^+, OH^-}{\Longleftrightarrow} CO^{-NH-CH_2OH}_{-NH_2}$$

Methyrolylation Reaction (Addition Reaction)

$$CO^{-NH-CH_2OH}_{-NH_2} + CO^{-NH_2}_{-NH_2} \overset{H^+, OH^-}{\Longleftrightarrow} CO^{-NH-CH_2-}_{-NH_2} {}^{HN-}_{NH_2-}CO + H_2O$$

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Methylenation Reaction (Condensation Reaction)

The relationship between the pH of the medium and the rate constants is:

$$k_1=0.56\cdot10^{-4}+0.14[H^+]+1.7[OH^-],\ m^3/(kmol\cdot s)$$

$$k_2=1.8\cdot10^{-6}+0.004[H^+]+0.05[OH^-],\ S^-$$

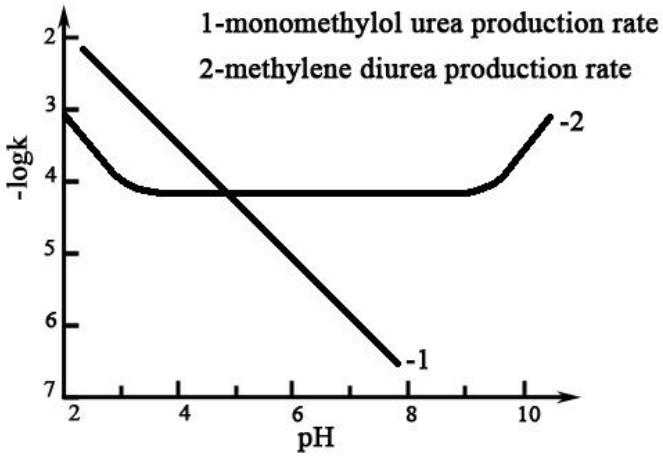
where k_1- forward rate constant;

k_2- inverse rate constant.

The production reaction of dimethylol urea also follows the same trend as that of monomethylol urea. Thus, the rate of methyrolysis reaction (addition reaction) is slow at neutral, higher acidity and faster at higher basicity. It is also faster in basicity compared to the addition reaction in acidic and basic. The condensation reaction rate slows down at higher pH.

The effect of the pH of the medium on the rate of addition and condensation reactions is shown in the following graph.

Fig. 1. Effect of pH (temperature 35 °C) on the rate of addition and condensation reactions



As shown in the graph, the condensation reaction rate in the alkaline region is slow, but the addition reaction rate is very fast. Hence, the urea resin produced in the basic medium is not actually a polymer, but a condensation of methylol ureas with a degree of polymerization of 1-3. Thus, the production of urea resins in weakly alkaline media, i.e. organic catalysts, is a guarantee for the preparation of emulsified urea-formaldehyde water-soluble adhesive resins.

In addition, depending on the molar ratio of urea to formaldehyde, the storage stability, adhesiveness, curing time, compatibility, and free formaldehyde content of the resins are affected, typically in the ratio of 1:1.5 to 2.5, and the reaction temperature depends on the content of free formaldehyde, so we adjusted the reaction time between 0.5 and 1 h at the reaction temperature of 70-80 °C.

Next, the curing process of urea-formaldehyde resin is an extension of the addition condensation reaction, which, as shown in Fig. 1, accelerates the condensation reaction in the acidic medium, resulting in the formation of a three-dimensional network with the increasing degree of polymerization of urea resin. Thus, the urea resin curing is usually used as a latent curing agent to accelerate the curing process in the product forming stage. However, when the pH of the medium is neutral or weakly basic, the condensation reaction occurs, and the higher the temperature, the faster the condensation reaction rate.

Hence, we have developed an emulsion-type urea-formaldehyde water-soluble resin material that has been incubated for 24 h after an organic-catalyzed urea-formaldehyde initial condensation reaction followed by the addition of urotropin as a curing agent to improve its storage stability, water resistance and adhesion strength.

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Method of producing plumage pads using new adhesives

Formulations for the preparation of UF resin emulsions

Combination recipe of plume base resin treatment solution in plastic immersion machine with emulsion urea resin as feedstock is shown in the following table.

Table 1. Comparison of bottom resin tre**atments used in the resin immersor**

Material	**old(g)**	**new(g)**
UF emulsion resin	-	100
Acrylic Resin Emulsion (DR501)	100	-
thickener (DR402)	11	20
ammonia water	1.5	-
water	200	250

To further improve the properties of the new urea resin emulsion, the acrylic resin emulsion was used as an additive rather than as a feedstock, so that the properties of the resin adhesive were much better than those of the sole material.

Combination recipe of feather, fabric-based dotted resin treatment solution through cylindrical screen of interlining machine is as follows:

Table 2. Comparison of the formulation of the spotted plastic treatment solution used in the drum screen

Material	**old(g)**	**new(g)**
UF emulsion resin	-	100
Acrylic Resin Emulsion (DR501)	100	6
thickener (DR402)	5	30
ammonia water	a little	a little
water	15.5	50

Process for producing powdered adhesion wind

The process and method of producing powder-sprayed adhesive interlining are as follows.

The bottom resin adhesive can be used after weighing the raw materials as prescribed at room temperature and stirring for 10-15 min.

The method of preparing the spot-patterned resin adhesive in the interlining can be prepared by the following process:

After adding the raw materials as prescribed at room temperature, add ammonia water with stirring to adjust the viscosity of resin adhesive. The resin adhesive used in the previous process was gelatinized, dried, cured and hardened over time at room temperature after manufacture, so that the storage stability of the resin adhesive solution was low and it had to be used within 24 h after manufacture. In addition, when the ground fabric was treated with a dotted glue through a fine hole in a cylindrical screen, it was found that it was necessary to dry-cured at room temperature to fill the screen hole, set the machine at 3-4 h intervals during production and clean the screen with organic solvents. On the other hand, the remaining plastic adhesive after production had to be hardened over the period of use and had to be discarded, resulting in the waste of a lot of materials.

However, the newly developed resin adhesive has been gelatinized with ammonia water at room temperature,

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exhibiting viscosity, and when ammonia gas is released over time, it is converted back into an emulsion sol, changing the pH of the solution, thus raising the storage stability of the solution and adjusting the pH to be recycled, thus increasing the utilization of materials and completely overcoming the existing shortcomings.

This is because the emulsion-type urea resin, which has good storage stability and good adhesion in the resin adhesive system, constitutes the feedstock.

Production process and production method of adhesive interlining are as follows:

Process and methods for processing substrate plastics: Prepared substrate of interlining of collar is subjected to dip-drying-heat treatment in a resin immersor and a heat treatment machine.

At that time, water squeezing pressure shall be 0.2~0.4 and drying temperature shall be completely dried at 90℃ max.

And then heat treatment shall be done at 165℃ and 20 m/min.

Process and methods for producing adhesion interlining (interlining of collar, fabric interlining) in welding: The pad heat treatment temperature of 175-180 °C, production rate of 7-9 m/min, and polyester powder resin (DR501) powder rollers produce padded powder-spun adhesive pads at 4-4.5 Hz.

CONCLUSION

In this paper, a novel emulsified urea-formaldehyde aqueous liquid resin was applied to the textile finishing process of the textile industry to realize the diversification and diversification of fabrics.

As it is an adhesive material, it has been applied to improve the fastness of dyes such as red and black disperse dyes to improve the fastness of poorly fastened dyes such as red and black disperse dyes to prevent color staining in coated bag cloths and further improve the quality of bag cloths.

In addition, the developed urea resin emulsion was transferred to a three-dimensional network structure during heat treatment, which has thermoset and good shape stability, and was introduced into the production of a fabric such as curtain cloth to diversify the kind of fabric.

The newly developed emulsion urea resin was applied as a pretreatment of rubber-fiber adhesion due to its good adhesion with fibers, and it was introduced into the production of rayon cloth for various weavers.

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