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DYEING FIBROUS SHEET MATERIAL

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This invention relates to a process of making dyed lignocellulose hardboards having one smooth side and an opposite screen-imprinted side from hydrolyzed lignocellulose fibrous material formed into porous sheets, and more particularly to such a process in which the boards are uniformly dyed on both sides but non-uniformly dyed therebetween.

Heretofore it was conventional practice to apply the dye to the sheet by a pan prior to passing the sheet between squeeze rolls under pressure. While this method works fairly well, it has drawbacks. For example, the surface color of the boards is not consistently uniform; the pressing cycle used to form the boards must be increased; more dye is required to dye a given area; if dyed and non-dyed runs are made alternately on the same processing unit, all the boards at the first of the non-dye run will be discolored and unsuitable, because the water supply system will become contaminated with the dye mixture during the dye run. All this amounts to a considerable decrease in production and increase in cost of production.

An object of the present invention is to provide a process of making dyed hardboards of fibrous lignocellulose material having one smooth side and an opposite secreen-imprinted side, said boards being dyed uniformly on both sides but non-uniformly dyed therebetween. Another object is to provide such a process further characterized by permitting increased and more economical production. An additional object is to provide such a process which substantially eliminates the drawbacks set forth in the above paragraph. Other objects will be apparent from the description of this invention given hereinafter.

The above objects can be accomplished according to the present invention by carrying out the process comprising forming hydrolyzed lignocellulose fibrous material into a porous sheet from a water slurry thereof, passing the sheet between squeeze rolls under pressure, spraying only the top side of the sheet with dye, then placing the sheet on a screen with the sprayed side of the sheet up and subjecting the sheet to consolidating heat and pressure, whereby the dye penetrates the sheet in such manner that the smooth side of the resulting hardboard product is uniformly dyed to a substantial depth and the screen side is uniformly dyed to a substantial but less depth, whereas the intermediate portion thereof is non-uniformly and sparsely dyed.

Dyes preferred in this invention include acid

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dyes, direct dyes, and mixtures thereof. With acid dyes a fixing agent is required. Likewise a fixing agent is used with a mixture of an acid dye and a direct dye if the acid dye predominates in the mixture. With direct dyes no fixing agent is required.

"Fixing agent" as used herein is intended to include materials which are instrumental in concentrating the dyeing action on the fibers on and near the smooth surface of the board and yet permit uniform dyeing of the screen surface of the board with non-uniform and sparse dyeing of the intermediate portion of the board, as more fully described herein. More specifically, such fixing agents include metal salts as for example aluminum sulfate, sodium chloride, alums, and the like. The alums are preferred, commercial alum being specifically preferred.

In practicing this invention according to one embodiment thereof, lignocellulose material, for example wood chips from trees, was explosively fiberized by subjecting to heat and pressure in the presence of moisture in a gun (such as shown in U. S. Patent 1,824,221 to Mason) and discharging to atmospheric conditions through a restricted opening in the gun. This fiber was refined, washed, and made into a water slurry of about 98% water by weight, from which a porous sheet or wet lap was formed on a Fourdrinier type machine. As the wet lap passed along the machine it first lost water by natural drainage and later by passing over suction boxes to a water content of about 87%. Then the wet lap was passed between squeeze rolls, dropping in water content to about 61% and in thickness from about 2" to ⅞" (the water content and thickness of the wet lap will vary somewhat. The thickness here was based on a ⅛" thick desired finished product.)

Following these conventional steps, the partially dewatered wet lap was sprayed with a water solution of a dye mixture (acid dye mixed with a direct dye, the acid dye predominating) including a fixing agent for the dye from a series of sprays arranged in rows about 7" above the wet lap following the squeeze rolls. The dye mixture was sprayed at a temperature of 150° F.–160° F under about 6.5 pounds gauge pressure onto the roughly 4' wide wet lap at a rate of about 32 gallons per 1000 square feet.

After spraying, the water content of the wet lap was 65.4%. The dye-sprayed wet lap was cut into predetermined lengths, placed on a wire screen and loaded into a multi-platen press. The

wet lap was subjected to a temperature of 400° F.–550° F. and an initial pressure of 400–500 pounds per square inch applied for about one minute followed by a reduced pressure of 100–150 pounds per square inch applied for about six minutes. This resulted in a hardboard product (specific gravity of about 1–1.05) having the smooth side dyed uniformly to a substantial depth, having the screen side dyed uniformly to a substantial but a less depth and having the intermediate portion thereof non-uniformly and sparsely dyed. Most of the water in the wet lap is removed during application of the initial pressure and most of the consolidation is obtained during application of the reduced pressure.

The dye mixture used according to this particular embodiment of the invention was prepared as follows: 255 pounds nigrosine crystals (115% concentration) and 13.5 pounds Brilliant Paper Yellow (125% concentration) were mixed with water at 150° F.–160° F. and screened through a 40 mesh screen. Thirty pounds commercial alum (i. e. K_2SO_4, $Al_2(SO_4)_3.24H_2O$) as a fixing agent was likewise mixed with water and screened. The resulting alum and dye mixtures were then mixed with additional water to a total of 925 gallons of water and heated to 150° F.–160° F.

Under substantially the above procedure a 1% aqueous solution of Calcomine Black 200% was used with good results at the rate of 11.8 pounds of dye per 1000 square feet of board. No fixing agent was used because this is a direct dye.

Other direct dyes and mixtures thereof well suited for this invention include Pontamine Fast Turquoise 8 GL, Pontamine Sky Blue 6 BX, Pontamine Fast Turquoise 8 GL–Brilliant Paper Yellow mixture, and the like. Other acid dyes and mixtures well suited for this invention include Brilliant Crocein FL, extra concentrated; Pontacyl Green BL, extra concentrated 200%; Crocein Scarlet N extra; Napthol Green B; Napthol Green B mixed with minor portion of Pontamine Fast Turquoise 8 GL; and the like.

During application of the initial pressure most of the water is forced or flushed down through the sheet to the screen beneath and out of the press. In passing through the sheet and out of the press there is a natural tendency for the water to carry a large portion of the dye with it when using acid dyes without a fixing agent, thus resulting in spotty dyeing on both sides of the finished board and wasting of the dye. However, when alum, or equivalent material, is included in the dye, the dye uniformly colors the smooth side of the sheet to a depth of about one-third the thickness of the sheet (i. e. one-third of the way through a finished board ⅛'' thick). The alum appears to hold back or fix the dye in a concentrated state uniformly in said upper portion of the sheet. The fiber has sufficient affinity for direct dyes so that this flushing difficulty is avoided without the use of a fixing agent. Then the dye passes through the sheet to the screen. The screen spreads the dye over the screen side of the sheet, allowing the dye to uniformly color the screen side of the sheet to a slight depth. Only a very small amount of the dye leaves the press with the waste water. The surprising feature of this invention is that in passing from said upper uniformly dyed portion of the sheet to said lower uniformly dyed portion, the dye passes through what appear to be disconnected and scattered channels and imparts non-uniform color to this central portion of the sheet. That is, the color of most of the fiber in this central portion of the sheet is unaffected by the passage of the dye therethrough.

The outstanding advantages of this invention over the prior art include (1) consistently uniform coloring of both sides of the board in conjunction with non-uniform and scattered coloring throughout the central portion of the board, (2) increased production (about 10 to 15%) by requiring less pressing time and increased wet lap machine speed, (3) reduced cost of production (about 15%) by less amount of dye required, and (4) permits alternate dyeing and non-dyeing runs to be made on the same unit without loss of boards from discoloration thereof at the beginning of the non-dyeing run (about 10% loss in production results, based on 8 hour runs of each, if dyeing and non-dyeing runs are alternated in the prior art method).

While the instant invention has been described with particular reference to a particular embodiment thereof, it is not limited thereto. Although other dyes (e. g. basic dyes, sulfur dyes and vat dyes) may be used, they are less practical than the acid and direct dyes. However, in the event they are used, no fixing agent is required with them because in this respect they are like direct dyes. The light fastness of basic dyes is less than that of the acid and direct dyes. Sulfur and vat dyes require more control than do the acid and direct dyes in order to maintain the hydrogen ion concentration relationship between that of the board and that of the dye.

Obviously the portions and ingredients in the dye and the amount of dye solution applied may be modified according to the particular color and other requirements desired. For instance application of 34 gallons per 1000 square feet of a dye mixture consisting of 170 pounds of nigrosine crystals, 9 pounds of Brilliant Paper Yellow and 30 pounds of commercial alum dissolved in 925 gallons of water gave satisfactory results. The water content of the wet lap after spraying was 65.4% in this instance. Preferably the water content of the wet lap will not substantially exceed about 66% after being sprayed with dye, in order to avoid possible difficulty in handling and pressing. However, this is not of great concern from a practical standpoint because a relatively wide variation in the concentration of the dye or the amount of dye applied makes only a slight difference in the water content of the wet lap.

The pressing conditions can be varied over a wide range and seem to be more dependent on what properties are desired in the finished board products than on the dyeing desired. Good dyeing and good boards of around 0.9 specific gravity are obtained by using an initial pressure of about 200 pounds per square inch applied for about one minute and then a reduced pressure of about 60 pounds per equare inch applied for about 15 minutes, the temperature being about 400° F.–550° F. Further the invention is applicable to a pressing cycle in which the pressure is applied in essentially one step and at a reduced temperature, as contrasted with an initial high pressure and a final reduced pressure. Good dyed boards can be made by subjecting the sheet to a pressure of approximately 200–700 pounds per square inch at a temperature of approximately 315° F.–350° F. until the boards reach a specific gravity of approximately one. However, application of an initial high pressure followed by application of a final reduced pressure is preferred.

As the above and other apparently widely dif-

ferent ambodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. Process of dyeing fibrous lignocellulose material to form a screenback hardboard having uniformly dyed smooth side and a uniformly dyed screenback side with the portion between the two sides non-uniformly and sparsely dyed which consists essentially of forming hydrolyzed lignocellulose fibrous material into a porous sheet from a water slurry thereof, passing the sheet between squeeze rolls under pressure, spraying only the top side of the sheet with dye, then placing the sheet on a screen with the sprayed side of the sheet up, and subjecting the sheet to consolidating heat and pressure to form the sheet into a hardboard and simultaneously obtain uniform dyeing of the hardboard on the upper smooth side and on the screen side and with the portion between the smooth and the screen sides non-uniformly and sparsely dyed.

2. Process of making dyed hardboards of fibrous lignocellulose material having one smooth side and an opposite screen-imprinted side which consists essentially of forming hydrolyzed lignocellulose fibrous material into a porous sheet from a water slurry thereof, passing the sheet through between squeeze rolls under pressure, spraying only the top side of the sheet with dye, hot pressing the sheet on a screen with the sprayed side of the sheet up causing the dye to uniformly color the smooth side of the sheet to a substantial depth and to non-uniformly color and penetrate the remainder of the sheet to the screen which uniformly spreads the dye over the screen side of the sheet and permits the dye to uniformly color the screen side of the sheet to a substantial but less depth, and finally subjecting the dyed sheet to consolidating heat and pressure.

3. Process of making dyed hardboards of fibrous lignocellulose material having one smooth side and an opposite screen-imprinted side which consists essentially of forming hydrolyzed lignocellulose fibrous material into a porous sheet from a water slurry thereof, passing the sheet through between squeeze rolls under pressure, spraying only the top side of the sheet with an acid dye including a fixing agent for the dye, hot pressing the sheet on a screen with the sprayed side of the sheet up causing the dye to uniformly color the smooth side of the sheet to a substantial depth and to non-uniformly color and penetrate the remainder of the sheet to the screen which uniformly spreads the dye over the screen side of the sheet and permits the dye to uniformly color the screen side of the sheet to a substantial but less depth, and finally subjecting the dyed sheet to consolidating heat and pressure.

4. Process of making dyed hardboards of fibrous lignocellulose material having one smooth side and an opposite screen-imprinted side which consists essentially of forming hydrolyzed lignocellulose fibrous material into a porous sheet from a water slurry thereof, passing the sheet through between squeeze rolls under pressure, spraying only the top side of the sheet with an acid dye including an alum as a fixing agent for the dye, hot pressing the sheet on a screen with the sprayed side of the sheet up causing the dye to uniformly color the smooth side of the sheet

to a substantial depth and to non-uniformly color and penetrate the remainder of the sheet to the screen which uniformly spreads the dye over the screen side of the sheet and permits the dye to uniformly color the screen side of the sheet to a substantial but less depth, and finally subjecting the dyed sheet to consolidating heat and pressure.

5. Process of making dyed hardboards of fibrous lignocellulose material having one smooth side and an opposite screen-imprinted side which consists essentially of forming hydrolyzed lignocellulose fibrous material into a porous sheet from a water slurry thereof, passing the sheet through between squeeze rolls under pressure, spraying only the top side of the sheet with direct dye, hot pressing the sheet on a screen with the sprayed side of the sheet up causing the dye to uniformly color the smooth side of the sheet to a substantial depth and to non-uniformly color and penetrate the remainder of the sheet to the screen which uniformly spreads the dye over the screen side of the sheet and permits the dye to uniformly color the screen side of the sheet to a substantial but less depth, and finally subjecting the dyed sheet to consolidating heat and pressure.

6. Process of dyeing fibrous lignocellulose sheet material which consists essentially of forming hydrolyzed lignocellulose material into a porous sheet from a water slurry thereof, passing the sheet between squeeze rolls under pressure, spraying the top side of the sheet with dye, flushing the dye through the sheet and removing a portion of the entrained water under pressure whereby the bottom surface of the sheet is uniformly dyed, and then subjecting the dyed sheet to consolidating heat and pressure.

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