Using ultrasonic treatment on wood veneer dyeing

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Abstract: The purpose of this research is to change the microstructure of wood using ultrasonic processing, increase the connectivity between pores in the cell to improve the permeability of the wood; ultrasonic cavitation dye in the wood veneer by the instinstantaneous temperature, high pressure, high jet role in the infection rate has been markedly improved. In the same time under the conditions of the veneer Ultrasonic assisted dyeing dye than conventional high temperature dip. Veneer dyeing dye uptake an yeing rate increases with the enhancement of ultrasonic vibration time increases with the increase of dye concentration increased with the improvement of the dyeing temperature increase.

With solid mu fu joins a floor board and furniture industry on dyeing timber demand increases, more than 3 mm thickness of the single homogeneous dyeing problem due to the increasingly prominent in wood for dye solution to move or penetrating horizontal channel is few, the greater the thickness of wood dyeing the more difficult to dye penetration of wood dyeing essence is dye in wood of infiltration and fixed with two process, if the wood permeability good, dye in sessile former is easy to reach inside and outside a uniform color. Dye penetration performance depends on the types of wood and its state dye molecular size and physical and chemical properties of medium physical and chemical properties and dyeing external conditions.

Wood dyeing process is dye solution in wood surface wetting diffusion adsorption, and dye solution to wood internal penetration and fixation process. The lumber size is big, dye molecules in the wood mobile and penetration depth is the key to real wood dyeing. This study adopts ultrasonic auxiliary dyeing is the use of ultrasonic cavitation to change the wood conventional dyeing auxiliary dyeing to achieve the purpose of the article.

Materials and methods

Experimental material

Wood Oak veneer (100 mm 100 mm 1.3 mm) 36 piece from the forest Jiao river.

Agent Acid lake blue, penetrating agent sodium sulphate (Na2SO4· 10 h2o), all stain (NaCl).

Instrument ltrasonic cleaning apparatus (origin: kunshan), TU - 1810 uv-vis spectrophotometer (origin: Beijing general analysis universal instrument co., LTD.), 722 n visible spectrophotometer (origin: Shanghai save division instrument table co., LTD.),etc.

Test method

Veneer pretreatment

Preparation 0.3% NaOH solution installed in 2000 ml beaker, beaker placed in water bath pot heating, until the temperature reaches 80 warm after temperature to the oak veneer completely submerged in NaOH solution, cooking 3 hours after treatment out put into this drying oven drying to moisture content 12 (1) %.

Ultrasonic auxiliary dyeing

This experimental design three kinds of pretreatment process for:

(1)Different dyeing time the veneer of ultrasonic auxiliary dyeing test after drying to the thickness of 1.3 mm oak veneer as test materials, in the dye solution concentration was 0.1%, bath ratio for 1:30, in the dyeing temperature respectively for 70, 80 and 90 under the condition of cooking 12 hours for 12 hours 2 cycle of ultrasonic auxiliary dyeing.

(2)Different shock time of ultrasonic auxiliary dyeing test after drying to the thickness of 1.3 mm

thick oak veneer as test materials, in the dye solution concentration was 0.1% temperature for 80, bath ratio for 1:30, at every hour shock time respectively for 10 min 20 min and 30 min under the condition of cooking 12 hours for 12 hours 2 cycle of ultrasonic auxiliary dyeing.

(3) Different dye solution concentration of ultrasonic auxiliary dyeing test after drying to the thickness of 1.3 mm ring oak veneer as test materials, in the dye solution concentration were 0.05%, 0.1%, 0.15%, temperature for 80, bath ratio for 1:30, cooking 12 hours for 12 hours 2 cycle of ultrasonic auxiliary dyeing.

Dyeing rate measurement

The dye uptake rate defined as:

Dye-uptake $= \frac{I_0 - I_1}{I_0} \times 100\%$

Type: I_0--a before dyeing of dye solution absorbance:I_1-- after dyeing of dye solution absorbance

Each dye has its specific maximum absorption wavelength, select the maximum absorption wavelength measurement dyeing and dye solution absorbance, can find out the dyeing rate.

The results and analysis

To dyeing temperature, ultrasonic oscillations time, dye solution concentration factors for the three factors three levels veneer dyeing orthogonal experimental plan, the test factors and level see table 1.

Table 1 orthogonal test factor and level

Level of factor	Temperature A(℃)	density B(%)	Turbulence timing C(min/h)
1	70	0.05	10
2	80	0.1	20
3	90	0.15	30

Through the TU - 1810 uv-vis spectrophotometer to measure the dye solution the maximum absorption peak of 505 nm, see figure 1

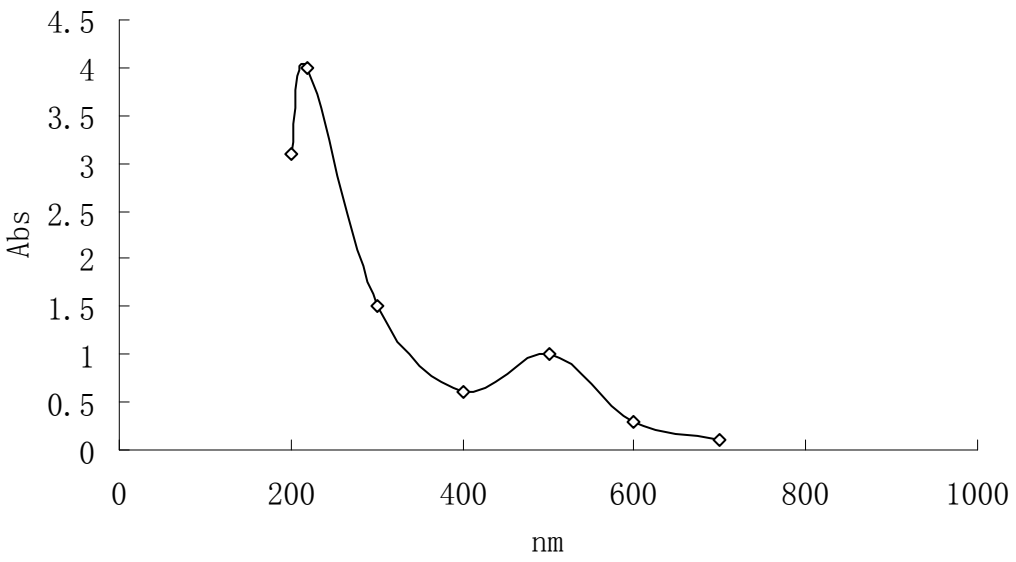

Figure 1 maximum absorption peak

Through the 722 n visible spectrophotometer measured dye solution absorbance, calculate the dyeing rate, see table 2.

Table 2 orthogonal test table

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line number / Test nunmber	A	B	C	dye-uptake %
1	70	0.05	10	70.32
2	70	0.1	20	72.80
3	70	0.15	30	74.90
4	80	0.05	20	79.68
5	80	0.1	30	78.40
6	80	0.15	10	78.60
7	90	0.05	30	88.40
8	90	0.1	10	85.70
9	90	0.15	20	88.10
K1	218.02	238.40	234.62	
K2	236.68	236.90	240.58	
K3	262.20	241.60	241.70	
$\overline{K_1}$	72.34	79.47	78.21	
$\overline{K_2}$	78.56	78.63	80.19	
$\overline{K_3}$	86.93	80.20	80.57	
R	14.59	1.57	2.36	

The table of K1, K2, K3 are shown in all factors level dyeing rate on the sum of $\overline{K_1}$, $\overline{K_2}$, and, $\overline{K_3}$ respectively in each level said factors under the average of the dyeing rate.

Factors that average

1) Dyeing temperature (factor A) in A horizontal 3 (90) specimens of dyeing in dyeing the highest rate

2) Ultrasonic oscillations time (factor C) in water quality 3 (30 min/h) specimens of dyeing the highest rate

3) Dye solution concentration (factor B) in a horizontal 3 (0.15%) of the specimen dyeing rate in the highest

Temperature

In other conditions phase at the same time, relatively low temperature, the dyeing rate is also low, as the temperature increases, the dyeing rate increased with

Dye solution concentration

In other conditions phase at the same time, the dyeing rate along with the increasing of the concentration of dye solution increased

Shock time

Other conditions in the same circumstances, the dyeing rate varies with ultrasonic oscillations time increased, when shock time more than 20 min/h, dyeing rate tends gradually smooth because of moisture absorption and analytic tend to balance, so that the dyeing rate in balance.

Conclusion

1) With 0.3% NaOH solution after pretreatment of oak veneer of dyeing rate is obviously higher than that of the same conditions after the conventional dyeing of oak veneer dyeing rate.

2) After ultrasonic auxiliary dyeing of get of oak veneer of dyeing rate is higher than the same condition conventional dyeing oak veneer of dyeing rate.

3) The ultrasonic dyeing, the same conditions, the higher the temperature, the dyeing rate is

higher.

4) By ultrasonic dyeing, the same conditions, the higher the concentration of dyeing, the dyeing rate is higher.

5) Using ultrasonic dyeing, the same condition, the shock time is higher, the dyeing rate is higher, when shock time more than 20 min/h, dyeing rate tends to be stable.

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References

[1]Zhao Guangjie.Wood dye aqueous solution of the process of osmosis. Journal of northeast forestry university,1993(5):54～59.

[2Base too village yoko,1Wood dyeing (the first newspaper) wood す よ び wood composition の chromaticity. Wood learn to volunteer .971(7):292～297.

[3] Wu well rise. Dye の wood の dyeing with sexual. Coating technology,1995(2):77～81.

[4]Li Chun-shen, WangJinLin, WangZhiTong, QuFang. Wood dyeing computer color matching technology [J].journal of wood industry,2006,20(6): 5～7.

[5] Wulin, YuZhiMing computer color matching technique is applied to wood dyeing trial [J].journal of man-made board,2006(8):17～20.

[6 Wulin, YuZhiMing computer color matching technology in the application of dyeing wood even cylinder [J]. Journal of Beijing forestry university,2007,29(l):146～150.

[7]Suslick, K.S. The Chemical Effects of Ultrasound[J],Scientific American,1989(2),260:80～86.

[8] Suslick. K.S .The Chemistry of Ultrasound in Encyclopaedia Britannica Year book of Science and the Future 1994,Britannica:Chicago;1994:138～155.

[9] GaoShuZhen. Ultrasonic dyeing process to the promoting function of study [J]. J printing and dyeing,1999,(2):5～8.

[10] YeJinXin. Ultrasonic for textile fabrics dyeing effect and industrialization [J]. Modern textile technology,2004,12(3):43～45.

[11] WangAiBing, ZhuXiaoYun, Yang bin. Ultrasonic technique and its application in dyeing and finishing process [J].journal of knitting industry,2004(1):99～102.