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Melamine Processing and Mathematical Modelling of Melamine Drying in Wood

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Abstract

Melamine wood is a coating that makes wood shiny. In this model, the Moisture Ratio formula is obtained from the melamine process. The formula is $MR = a + bt$, where a and b are empirical constants in drying models and values a and b depending on the ambient temperature.

***Keywords**: Melamine, Moisture Ratio, ambient temperature.*

Introduction

Melamine is a finishing process for wooden furniture. The purpose of melamine is to make wooden furniture last longer and looking good. Melamine is made from liquid and can make furniture beautiful and shiny. This melamine produces a shiny appearance.

This modelling is to determine the length of the drying process for melamine on wood. With this modelling can measure the drying time. This modelling uses linear equations.

Melamine Processing

The melamine processing are as follows. First, we prepared tools and materials. The tools and materials for melamine wood furniture are sandpaper with a roughness of 150, 400 and 1000, thinner, melamine hardener sanding sealer, melamine hardener topcoat clear (gloss/semi/dot), impra ML-131 Clear Dof. The second is caulking with holes in wood and coating the non-melamine components with plastic or paper, such as cupboard handles, hinges, and glass. The third is smoothing the surface of the wood with sandpaper. For sandpaper, we used the number of 150 then 400. The fourth is to apply a sanding sealer which aims to strengthen the melamine and protect the wood nagian. Before melamine use sandpaper number 1000. The fifth process is the melamine processing. The ratio between thinner, melamine and hardener is 20: 10: 1.

Figure 1. (A) Melamine material; (B) Original table before melamine processing; (C) Table after melamine coating.

Mathematic Modelling of the Melamin Drying Process

Table 1 is the drying curve of mathematical modelling and Table 2 is the drying curve mathematical model parameter.

Table 1. Mathematical model of drying curve.

No.	Equation	Model Name	Reference
1.	$MR = \exp(-kt)$	Lewis	Ayensu (1997)
2.	$MR = \exp(-kt^y)$	Page	Diamante and Munro (1993)
3.	$MR = \exp(-(kt)^y)$	Modified Page	Ozdemir and Devres (1999)
4.	$MR = a\exp(-kt)$	Henderson and Pabis	Henderson and Pabis (1961)
5.	$MR = a\exp(-kt) + c$	Logarithmic	Yaldiz et al. (2001)
6.	$MR = a\exp(-k_0 t) + b\exp(-k_1 t)$	Two-term model	Togrul and Pehlivan (2002)
7.	$MR = a\exp(-kt^n) + bt$	Midilli and Kucuk	Lahsasni et al. (2004)
8.	$MR = a\exp(-kt) + b\exp(-gt) + c\exp(-ht)$	Mod. Henderson and Pabis	Karathanos (1999)
9.	$MR = a\exp(-kt) + (1-a)\exp(-kat)$	Two-term exponential	Sharaf-Elden et al. (1974)
10.	$MR = a\exp(-kt) + (1-a)\exp(-kbt)$	Diffusion approach	Kasem (1998)
11.	$MR = a\exp(-kt) + (1-a)\exp(-gt)$	Verma	Verma et al. (1985)
12.	$MR = 1 + at + bt^2$	Wang-Singh	Wang and Singh (1978)

Table 2. Parameters of the drying curve mathematical model.

No.	Parameter	Description
1.	a, b, c, k, k_0, k_1	Empirical constants in drying models
2.	MR	Moisture ratio (dimensionless)
3.	M	Moisture content at any time
4.	M_e	Equilibrium moisture content
5.	M_0	Initial moisture content
6.	N	Positive integer
7.	$RMSE$	Sum square error
8.	t	Drying time (menit)
9.	y	Empirical constant in drying models
10.	wwb	Wet weight basis
11.	dwb	Dry weight basis

This melamine drying process is carried out during the day in the tropical climate. At the time of this process the ambient temperature is 31°C. The process from brushing to completely drying is 50 minutes. Meaning at time $t = 0$ minutes, Moisture Ratio value, $MR = 100\% = 1$, and at the time $t = 50$ minutes, Moisture Ratio value, $MR = 0$. We can write

$$(t_0, MR_0) = (0,1)$$
$$(t_1, MR_1) = (50,0)$$

The linear equation is

$$\frac{t - t_0}{t_1 - t_0} = \frac{MR - MR_0}{MR_1 - MR_0}$$

so that

$$MR = 1 - 0.02t$$

In general, the drying formula for the melamine process is $MR = 1 + at$, where a depending on the ambient temperature. Figure 2 is a curve for the drying process of wood melamine.

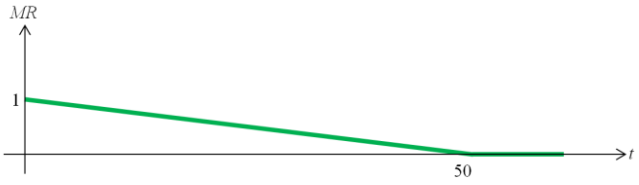

Figure 2. The curve of the melamine wood drying process.

We can write the Moisture Ratio for the melamine process,

$$MR = \begin{cases} 1 - 0.02t, & 0 \le t \le 50 \\ 0, & t > 50 \end{cases}$$

Conclusion

The wood melamine process is a coating that is applied at the final stage of wooden furniture. The Moisture Ratio formula obtained from this melamine process is $MR = a + bt$, where a and b depends on the temperature of the environment.

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