UNIVERSITI PUTRA MALAYSIA

THE QUALITY OF FINISHES ON PLANTATION GROWN TIMBER SPECIES

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ON PLANTATION GROWN TIMBER SPECIES

By

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ABSTRACT

Tests to determine the quality of finish of nitrocellulose and acid catalysed lacquer with and without sanding between coatings were conducted on four fast growing species, namely: batai, yamane, acacia, and rubberwood. The quality of finishes was evaluated in terms of machining ability, surface performace, surface gloss, adhesion ability, hardness, and flexibility of woodfinish. The testing methods were based on The British Standard No. 3962 part 6, 1980 and Draft of Malaysian Standard part 1, 1987.

The results indicated that on rubberwood, acacia, batai and yamane nitrocellulose lacquer had higher gloss and was more flexible than acid catalysed lacquer with and without sanding in between coatings. On the other hand, acid catalysed lacquer had greater hardness and higher adhesion ability than nitrocellulose lacquer with and without sanding in between coatings for all species.

In general the quality of nitrocellulose lacquer and acid catalysed lacquer on rubberwood was the highest, followed by acacia, yamane, and batai. Moreover, these species have a good machining ability and have a good surface performance, and the results showed rubberwood, acacia and yamane to be suitable for furniture.

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I. INTRODUCTION

Because of its unique properties, wood is suitable for general utility purposes such as construction and furniture. Gower (1988) commented that wood has a timeless quality that means it always appeals and it readily adapts to suit any lifestyle. The diversity of wood utilization increases with advancement in the technology of wood processing.

Wooden furniture will be with us for a long time, mainly due to its many desirable characteristics. No other material is like wood, which as it grows old in service, has its beauty enhanced. It can be finished to a rich warmth that can not be matched by any other product (Sim, 1983; Meyers & Richard, 1974).

Wooden furniture soon became a product which not only incorporated artistic values but also was considered to have a prestige value. Especially after the second world war, furniture and furniture components have entered world trade in large volumes. According to Bassilli, (1989) a number of factors are :

1. The increasing demand created by high living standards.
2. A more mobile population linked with the migration to towns leading to new lifestyles and the breaking up of the traditional family culture in many western countries.
3. The increase in local costs of raw materials and especially of labour and other production costs.

4. The change from craft or mechanized craft production methods to real serial production.

In addition Ambran, (1985) stated that demand for furniture in the mass consumer market will depend mainly on the state of the economy and disposable incomes of consumers and also on other factors such as the rate of population increase and the incidence of marriages.

The selection of raw material plays an important role. The furniture industry can, in many instances, serve as a promoter of the commercially less desirable species, since they can be used and tested locally, thus reducing possible overseas consumer resistance, such as in the case of rubberwood. Moreover, the prospects for forest plantations appear to be improving rapidly and small quantities of timber produced from fast growing species have been marketed successfully (Tuan, 1989). Some of the fast growing species that have been planted are acacia (Acasia mangium), batai (Paraserianthes falcataria), rubberwood (Hevea brasiliensis) and yamane (Gmelina aborea). These species are suitable for general utility purposes (Wong, 1974).

The advantages of plantation grown timber species are numerous. They will be homogeneous and their properties can be controlled by selection, breeding, and even genetic engineering. The relatively short rotation of the fast growing species means that investments could be economically viable and financially profitable.

Even though these species have high potential value for general utility purpose, they are not yet available in any quantity. It is hard to predict how acceptible these species may be in the market. However, there is a necessity to explore the potential of plantation species for downstream processing and added value. Lack of information on behaviour of plantation species related to finishing methods requires assessment.

In this project, four fast growing species were selected for studies on the quality of finishes , namely : acacia, batai rubberwood and yamane. They were treated by surface coating with Nitrocellulose lacquer (NC lacquer) and Acid Catalysed lacquer (AC lacquer) with and without sanding in between coatings.

The objectives of this project are as follows :

1. To establish whether, by standard preparation of timber surfaces and standard application of finishes, the common plantation grown timbers are satisfactory substrates for furniture finishes of the nitrocellulose and acid catalysed resin types.
2. To assess the effectiveness of modifications designed to improve finish quality, where this is found necessary.
3. To recommend appropriate furniture finishing techniques for these plantation species.

II. LITERATURE REVIEW

A. Wood Finishing

Wood finishing is the art and science of applying transparent, semitransparent or opaque surface coatings to preserve and accentuate the natural beauty of wood (Moredo, 1989).

Finishing the surface protects it against many destructive forces - soiling, warping and raising of the grain, cracking, checking and shrinkage by sealing the surface against the entry of moisture and humidity. Another advantage afforded by a well finished wood surface lies in the fact that it is easier to clean and to keep clean (Moredo, 1989; Ahmad, 1987).

Borretti (1988) commented that for industrially produced furniture to be succesful, it must be appealing in styling, must perform well and be competitive in price. The finish, more than any other factor, influences the saleability of furniture. Furniture finishing is a matter of fashion and always depends on the appeal that it will impart to the product as well as protecting the surface (Bassett, 1989).

A multiplicity of finishing materials is currently available for the surface finishing of wood, and there is also a great variety of methods for applying the

materials. The materials and methods applied must be suited to the wood properties, some woods are porous, some are dense, some are soft, some are hard, some are light, some are dark. All these qualities are important in determining the type of finish and degree of workability (Bistrom, 1977; Meyers & Richard, 1974).

B. Wood Properties Affecting Finish Performance

Tan, (1975)dan Salleh & Sim, (1979) stated that the properties of wood desirable in good furniture are sufficient strength, good machining properties, suitable density, dimensional stability and durability. In addition Borretti (1988) stated that durability and strength mean that furniture elements such as surfaces, can stand up to normal strains or tough usage as would be required in the case of furniture for public places. The main factors of durability and strength are related to end use requirements and concern the way the furniture is constructed, the type of joints and the choice of surface coating material, the choice of adhesives, and appropriate wood seasoning. Surface durability considerations are of prime importance when designing items such as tables whose surfaces may be marred by coffee, water, alcohol, grease, heat and scratching.

This suggests that only Moredo and Gallagher have made commment - in fact both are reporting the work of

others. Moredo, (1989) and Gallagher, (1989) stated that the properties of wood which have been found to affect the performance of applied finishes are moisture content, density or specific gravity, content of extractives, surface texture and natural defects such as knots.

1. Moisture Content

One of the most widely accepted causes of coating deterioration is related to dimensional changes which are associated with the changes in moisture content. Swelling and shrinkage on drying, create a shearing force that greatly affects paint behaviour (Moredo, 1989). Woods with low shrinkage and movement values are obviously to be prefered. Tan, (1975) dan Salleh & Sim, (1979) stated that with proper seasoning, wood less than 10 % moisture content will solve most of these problems. In addition Gallagher, (1989) reported that for the purposes of furniture manufacture, the generally accepted value is 12%. The result of research in the UK has shown that the moisture content of solid wood and veneer at the time of manufacture should be about 10 % (Anon, 1989[a]). Table 1 shows shrinkage values for some furniture timbers (Gallagher, 1989; Lim, 1986; Sim 1983; Anon, 1988; Anon, 1975).

Table 1. Shrinkage Values for Some Furniture Timbers

Timber	% Shrinkage	
	Rad.	Tang.
Light Red Meranti	2.0	3.0
Nyatoh	3.0	4.2
Yellow Meranti	1.8	4.8
Rubberwood	0.9	2.7

Table 1 shows that there are differences in the amount of shrinkage in radial and tangential directions. The tangential shrinkage is higher than the radial shrinkage. This means that there is unequal shrinkage of timber during drying, which can lead to many difficulties in usage such as surface cracking. Information of shrinkage values for acacia, batai and yamane are not published yet.

2. Density or Specific gravity

Moredo, (1989) and Kubler, (1980) stated that generally, woods of lower density have a greater paint holding capacity than those with higher density. On the other hand, the hardness of the surface and small size of wood cavities of denser species result in greater penetration of paint oil. Tan, (1975) and Salleh & Sim, (1979) reported that wood with density (oven dry) of

around 500 kg/m3 has been proved to be good enough for furniture.

Table 2 shows the density of acacia, batai and yamane compared with some species which are commonly used for furniture manufacture (Gallagher, 1989; Sim, 1983; Lim, 1986; Baharudin, 1987).

Table 2. Comparison of Density of acacia , batai and yamane to Some Furniture Timbers (kg/m3 at 12 % Moisture Content)

Timber	Density (kg/m3) Average	Range
Light Red Meranti	713	560 - 865
Nyatoh	738	400 - 1075
Yellow Meranti	655	575 - 735
Rubberwood	600	560 - 640
Acacia	450	420 - 483
Batai	330	234 - 430
Yamane	390	-

From the table 2 can be seen that the density of acacia, batai and yamane are relatively lower than those species which are the most commonly used for furniture manufacture. It may be difficult to finish these species. However, if the furniture is meant for general use, a timber strength comparable to or greater than that of light red meranti, a light hardwood density at

moisture content at 15 % would be acceptable for making furniture (Lim, 1986; Sim 1983).

3. Content of extractives

Dombey, (1985) reported that 5 % to 30 % of the dry weight of wood consists of soluble chemical extractives. Even small amounts of extractives can greatly affect the properties of wood and cause difficulties in finishing. For example extractives in rosewood (Dalbergia, spp) which may comprise up to 30 % of weight of this species, can affect its finish. Rosin in pine is liable to diffuse into a thermoplastic finish. A similar condition sometimes accurs in western red cedar, which contains terpenols. Inhibition of the drying of polyester finish on teak may occur, due to quinones interfering with the polymerisation mechanism.

Extractives also can cause discolouration, especially the polyphenols, which change to dark coloured compounds in the presence of light. Sometimes, the wood becomes reddish when certain types of lacquers are used. The discolouration tends to occur in patches and makes the finish items look unsightly. This type of discolouration is generally caused by extractives which change colour in the presence of acid curing lacquers (Anon, 1989[b]).

Dombey, (1988) reported that the group of extractives involved in this type of discolouration are collectively termed leucoanthocyanins, tannin like substances, normally colourless or of very pale colour, which in the presence of strong acids such as sulphuric or hydrochloric, change into red or purple forms.

Table 3 shows the extractives of acacia, batai and yamane compared with some species which are commonly used for furniture manufacture (Choon & P.T.Bin, 1982; Tachi,at al, 1988).

Table 3. Comparison of Extractives of Acacia, Batai and Yamane to Some Furniture Timbers (%)

Species	Extractives (%)
Light Red Meranti	3.3
Nyatoh	4.6
Yellow Meranti	2.8
Rubberwood	2.4
Acacia	7.5
Batai	4.0
Yamane	5.8

Table 3 above indicates that extractives of acacia, and yamane are relatively greater than those of light red meranti, nyatoh, yellow meranti and rubberwood which are the most commonly used for furniture industry.

4. Surface Texture

Borretti, (1988), stated that the texture in terms of furniture design is the arrangement of the structure of any material that affects the appearance or the feel of the surface such as the exposed grain of wood surface.

The texture of wood depends on the size of the cells and on their arrangement. A wood in which the cells have a very small diameter is said to be fine textured, while a coarse textured wood has a considerable percentage of large diameter cells (Dinwoodie, 1981; Wangaard, 1981).

Hardwoods with relatively large pores are poorly adapted to finishing. Kubler (1980) reported that rough wood with extreme porosity and exposed end grain are difficult to finish. Fine texture will give a smooth surface finish.

C. Finishing Material

There are various types of materials available as surface coatings to lend protection to the substrates; these are shellac, nitrocellulose, precatalysed and acid catalysed lacquers, polyurethane, polyester and UV radiation cured lacquers. The furniture idustries commonly use nitrocellulose and acid catalysed lacquers.