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RESEARCH ARTICLE

EXPERIMENTAL SANDING SEALER FORMULATION USING LOCALLY SOURCED RAW MATERIALS

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Abstract

Using sanding sealer for woodworking is a great way to seal the surface and allow your final topcoats to lay on the wood much smoother and with finer luster. This study reports on the experimental formulation of sanding sealer using locally sourced materials. The study addresses the problem of high drying time and stickiness of locally produced sanding sealer in Nigeria. This study seeks to obtain a lower drying time than the already existing local ones. The results point out that kerosene appears to outperform thinner in terms of dissolvability and capability to reduce drying time. Also, mixed dryer appears to be more effective in reducing drying time compared to other types of dryers. The optimum drying time obtained for the produced sanding sealer (OVIS) is seven minutes.

Introduction

Sanding sealer is a liquid coat that seals wood and prevents the surface from absorbing varnish. It is a hard first coat that seals without obscuring the grain of the wood . It helps woodworkers achieve a smooth, even finish on a wood furniture. By design, sanding sealer serves as a "sandable" sealer, which means it can easily be sanded after application without impacting its effectiveness on the wood [1]. Sanding sealer is typically very thin, and dries very quickly to condition the wood in order to allow for less lean time. By applying sanding sealer during the finishing process, woodworkers minimize rough textures and create a smooth finish. Sanding sealers are used to eliminate stains. It can be applied over wood stain or bare wood, depending on the desired appearance, but before any protective coating or finish [2]. This stains include those from water and fire damage. The sealer is then applied over the entire surface using a brush or foam pad after the stain is dried. The sealer must then be allowed to dry completely before proceeding to sanding [3]. The surface is then sanded using a sanding paper before subsequent coats are applied. Sealers may be transparent and sometimes act as primers. Some sealers are designed to be left uncoated and thus can also be used as a varnish, however this is not recommended [4].

Sealers are absorbed quickly by spongy woods, and this can prevent the formation of a film on the wood, leading to an effective seal. Sanding sealers contains zinc stearate, which helps it seal soft woods quickly and makes the wood easier to sand. However, if a lacquer finish is intended to be used above the sanding sealer, more than one or two coats should not be applied as a buildup of sealer can cause the lacquer to chip [5].

Studies have noted that sanding sealers are one of the keys to a really good finish[6] also notes that varnishes cannot be put aside in the timber industry as it not only helps to protect and preserve the wood from damage by atmospheric conditions and insects, but also gives the wood a shining or glossy look, thus imbibing into the wood a desired shape and colour. In addition, the literature under review postulated that varnishes are also relevant in the steel industry as it helps to guide against atmospheric and metallic defects thereby giving the metal a long life span [7].

In the current market, most sanding sealers which have good drying capability have not been able to meet users' requirements, prompting the present research study to attempt to calibrate the different qualities of the various available products, to produce sanding sealer of low drying time and also identify the raw materials that could be combined to obtain optimal sanding sealer formulation that would compete with already existing ones.

Following the above knowledge on the importance of varnishes and sanding sealers, a nation like ours (Nigeria) that is richly blessed with basic raw materials for surface coating manufacture, cannot retire to the importation of surface coating if she must reduce market cost of products obtainable from them as well as steer towards technological growth. The Government has realized this and has channeled much resources and efforts towards the improvement of local wood varnish technology, especially as a great number of our office and domestic furniture rely on these coatings for their aesthetic value and longevity. Researchers have carried out meaningful study in this direction. S.A.Omotehinse investigated the nested design wih application to quality enhancement of wood varnish manufacture [8]. The formulation for primer wood varnish produced in his design manifested a drying time of 11 minutes. Obviously, this result was good but can still be improved.

It is against this backdrop that this research study stands as an avenue for venturing into various ways of carrying out statistical experiment designs, which includes; Split-split plot design, Taguchi method, Hardamad matrix method, Nested (Hierarchal) design, House of Quality and linear programming; in an attempt to enhance the quality of the sanding sealer that is being produced. It is however pertinent to say that attention shall be focused on factorial experiments aimed at searching for a sanding sealer formulation that would allow for enhanced quality specification. These ideas will hopefully bring about ways or methods of blending solvents such as Toluene, Isopropyl alcohol, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), acetone and additives like zinc stearates and nitrocellulose chips together so as to produce a homogenous mixture or solution of sanding sealer. It should be noted that without zinc stearate, the mixture will be totally transparent since it is actually the sealant. Three replications of experiments shall be carried out in order to ensure extensive experimental controls, particularly the experimental variables or data that are instrumental to satisfying specifications of the product.

MATERIALS AND METHODS

This research study employed the use of various locally sourced chemicals such as Acetone, Toluene, Nitrocellulose, Secondary butyl Alcohol, Isopropyl, Zinc stearate, Methyl ethyl ketone (MEK), Methyl isobutyl ketone (MIBK), Dioctyl phthalate (DOP), Dibutyl phthalate (DBP) and hard resin. These chemicals were procured from Lagos state except for Zinc stearate and Nitrocellulose chips which were procured from Black Man Chemical Company, Ilorin, Kwara State, Nigeria. The basic raw materials selected to enhance optimal formulation of the product was added in line with the structure of the statistical experimental design [9]. However, the sanding sealer production was carried out by using variations of the necessary raw materials to probe for optimal mix of the product, in order to produce an improved grade that will outperform the already existing commercial ones. These commercial existing products are Sun bright, Longlax and Fine Coat which have an average drying time of 12, 10 and 13 minutes respectively. Longlax has the minimum on the three and therefore will act as a competitor.

The various data employed during the course of the study were obtained from various experimental runs carried out. The experimental observations obtained were recorded in terms of the drying time of the sanding sealer which was applied to the surface of the already prepared plywood. Three experimental runs were carried out. The acetone, zinc stearates, MIBK, Toluene and MEK were varied while other solvents were kept constant as shown in Table 1. Each of the data obtained were recorded and tabulated (Table 2).

The models that could be employed in this study are Taguchi method, Split-Split plot design, Linear programming model, Quality Function Deployment - the House of Quality, Nested design (Hierarchal) [10]. However, for the purpose of this research, Quality Function Deployment - the House of Quality was employed. A questionnaire (Appendix A) was given to one hundred consumers after testing the produced sanding sealer and this result was used to compute the House of quality analysis.

Table 1: Experimental run details showing varying formulation of materials

Components	*1st Runs (g)*	*2nd Runs (g)*	*3rd Runs (g)*
MIBK	75	70	75
Nitrocellulose	80	80	80
DOP	20	20	20
Toluene	65	60	65
Zinc stearate	10	15	15
Acetone	25	30	30
MEK	100	100	90
IPA	5	5	5
Total weight	380	380	380

RESULTS AND DISCUSSION

The results can be categorized into two: the experimental results and house of quality analysis obtained from questionnaire. Some tests were also carried out on the produced sanding sealer (OVIS) and that of the competitor (Longlax) to rate the design properties.

The experimental result for the three runs is shown in Table 2. Drying times of 13, 10 and 7 minutes was observed for the first, second and third runs respectively. This is also displayed graphically in Figure 1. The house of quality analysis is also shown in Figure 2.

Based on the experimental result in Table 1 and 2, investigations involve re-examination of the compositions of different constituents in relation to their inherent drying properties.Alkyd resins was introduced into the locally produced sanding sealer to improve the glossiness and appearance, making it also act as a wood varnish. However, this drastically increases the drying time of the sanding sealer. Thus the composition of the 3rd run gives the shortest drying time of 7 munuites. Comparison with the 1st and 3rd runs shows that the reduction in the MEK value substancially affects the degree of drying time. Also, more the acetone introduced, the higher the drying time, but it was introduced in a way that it does not outperform the Zinc stearate since it is the sealer itself. The percentage of Zinc stearate has a significant effect on the ability of the sanding paper to sand easily.

From the result of the Quality Function Deployment-House of Quality, it has been seen that the drying time of our Sanding sealer rises above that of our competitor, suggesting that our sanding sealer is of higher quality. Since this sanding sealer has a very low drying time, it can be competive with forign products. Hence, improving our locally made sanding sealer will greatly reduce the price of sealer in the market since raw materials can be readily available.

Table 2: Drying time of the three runs

	1st Run	2nd Run	3rd Run
Drying Time	13mins	10mins	7mins

Figure 1: Drying time of the three runs

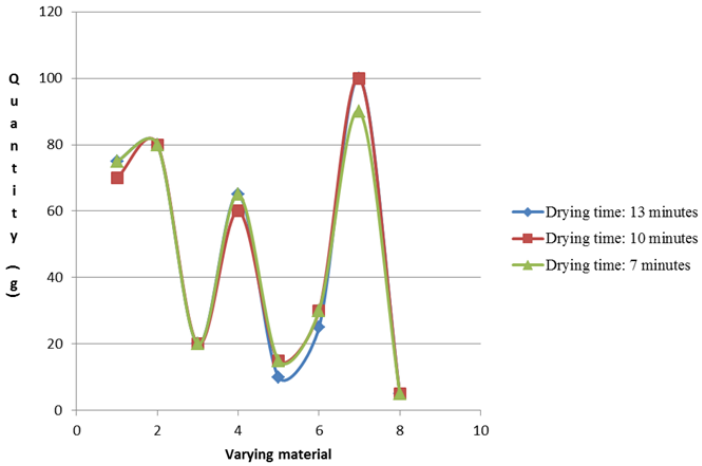
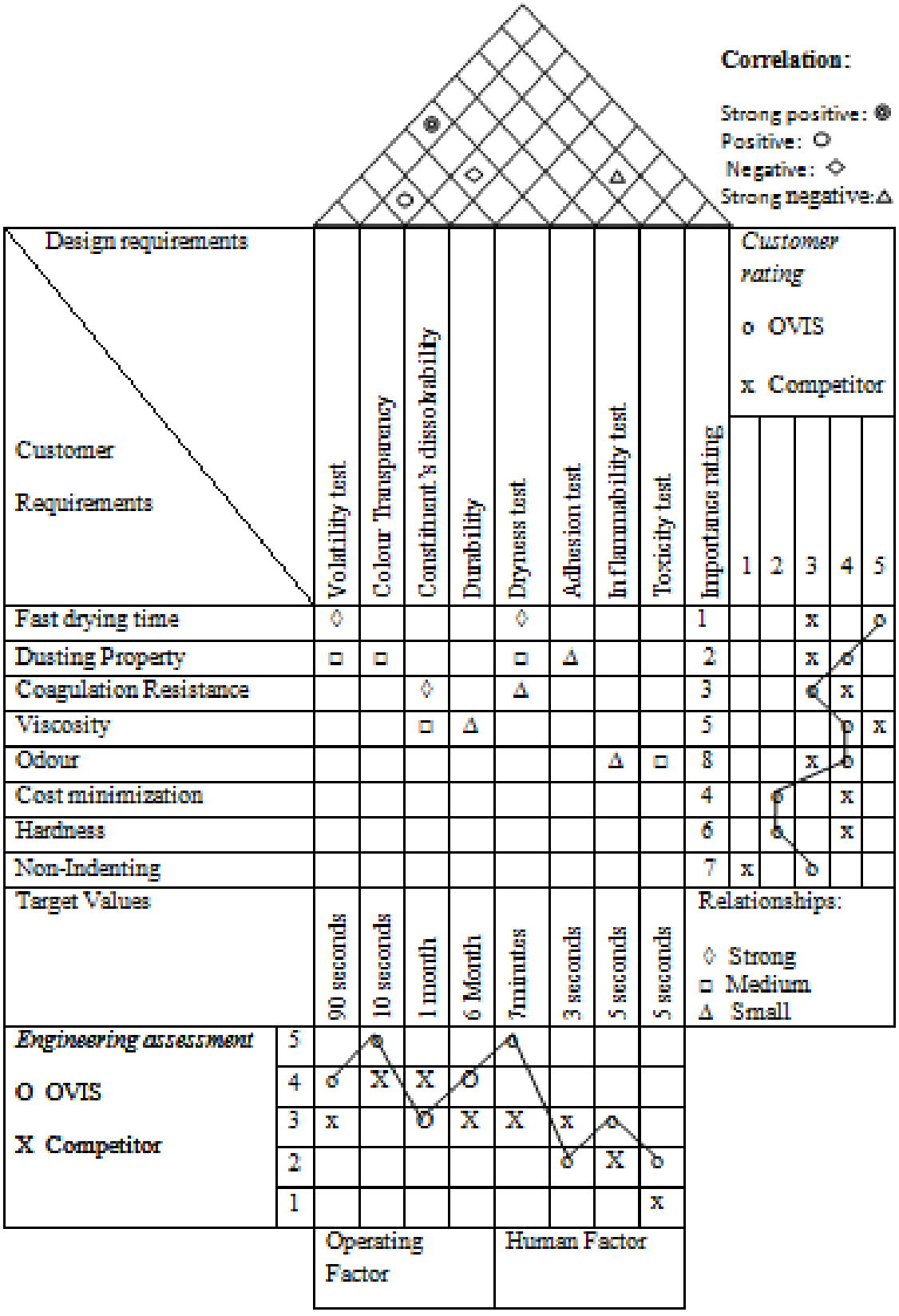


Figure 2: House of Quality Analysis



CONCLUSION AND RECOMENDATION

This study has attempted to improve the quality of locally manufactured Sanding Sealers. The minimum drying time for the sanding sealer produced was found to be seven minutes. Comparatively, locally produced sanding sealer has higher drying time. The produced sanding sealer also possesses dusting property on sanding paper. Hence, it is recommended that the the compositon of the sanding sealer utilized in this experiment should be adopted by local manufactures and made available in the market. It is suggest that dryers should not be used for sanding sealers but for other wood varnishes. Although, it should be inputted to test for reduced drying time and tolerability by the sanding sealer. Taguchi statistical method may also be fitted into the same data to ascertain if improved quality enhancement would result.

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Appendix A

QUESTIONNAIRE TO DETERMINE THE QUALITY OF OVIS

Please rank the following properties from 1 to 5, with 1 as the lowest and 5, the highest. Circle where appropriate.

Requirement	**OVIS**					**Competitor**				
1. Fast drying time	1	2	3	4	5	1	2	3	4	5
2. Dusting property	1	2	3	4	5	1	2	3	4	5
3. Coagulation resistance	1	2	3	4	5	1	2	3	4	5
4. Viscosity	1	2	3	4	5	1	2	3	4	5
5. Odour	1	2	3	4	5	1	2	3	4	5
6. Cost	1	2	3	4	5	1	2	3	4	5
7. Hardness	1	2	3	4	5	1	2	3	4	5
8. Non-indenting	1	2	3	4	5	1	2	3	4	5