

Improving Quality Level of Dining Table Through Painting Process by Using Taguchi Method

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ABSTRACT

In the process of painting a product, it commonly occur defect results including corrugated painting, perforated, less smooth, speckled and uneven surface of painting. This can occur due to the setting parameters in the process of painting is not appropriate. This research is done to reduce the high rate of defects in the process of painting products of table by setting parameters using the Taguchi method. Processing data using the Taguchi method are distinguished by two ways: (1) to see the impact of uncontrollable factors on the percentage of defective products and (2) to see the controllable factors to the variability of the number of defective products. Controllable factors in this study are: composition of paint, painting distance, pressure and temperature. The survey results revealed that a significant factor level against average and variability of percentage number of defective products are composition of the paint level 2 (0.75: 1), the distance painting level 2 (20-25 cm), pressure level 1 (50 psi fluid tip round 1.88 mm), temperature level 2 (60 ° C), sanding sealer level 2 (15-20 cm) and a clear top coat level 1 (20-2Q5 cm).

Keywords: Product Defects, Level factor, Taguchi

1. INTRODUCTION

The increasing demands of consumers and the development of science, technology, and information lead to changes in consumer tastes toward a product. Thus, consumer demand for the product will be more variety to fulfill the market segmentation that affects the tightness of the competitiveness of the company. One way to ensure that the product can compete and survive in the market is to control the quality of products. Furniture Company is a business that requires good quality control in term of aspects of components or finished products produced [1][2]. One important variable in the furniture company is the quality of painting process. One attempt to improve the quality of the product needs to be a good design parameter that defective products can be reduced. In this case the concept of quality control that is used is the Taguchi method [3][4].

Taguchi Concepts is a method to analyze a variety of variables and parameters in bulk and interactions among different variables to achieve a high quality which time and cost is relatively low [5][6]. The application of the method is expected to solve the problems of the company that is able to find the right parameters in reducing

defects so that the products produced are in accordance with the specification set [7].

1.1. Problems

Based on the background of these problems, the research is done to improve the quality of painting furniture product so that it is to reduce the level of defects by (1) determining a significant factor level against the contribution of defect rate (2) determining the sensitive parameters to lower defective products and (3) comparing the level of defects between the policies of the company with the proposal based on setting parameter.

2. METHOD

The quality of the product is a combination of characteristics products and services both in terms of engineering, manufacturing, marketing and maintenance so as to meet customer needs [8]. To produce products that have a strong performance, Taguchi introduced the design method in three stages Isa S(1) designing system that is an attempt to bring the concepts, ideas and methods to improve the quality of products (2) designing parameters, that is selecting the best design of controllable factors and minimizing the environmental impact (3) designing tolerance, that is the stage of range

to find a balance between making a loss (manufacturer) and buyer (consumer) products [6][9].

The Taguchi method is an effective method to reduce variation in products and processes through optimization process of designing the robust product using orthogonal array in the design of experimental procedures. Taguchi method also uses financial considerations through quadratic loss function to determine tolerance [10][5].

3. RESULT AND DISCUSSION

3.1. Results

In this study, there are two factors that can be identified as controlled factors and interference factors. Controllable factors are factors which its value can be set or factor which its value is to be regulated or controlled, while the interference factor is a factor which its value can't be regulated or controlled. Table 1 showing the control factors in the experiment. While uncontrolled factors are shown in Table 2. Table 3 is showing the results of calculation of average number of squares. Table 4 is showing first pooling effect factor ANOVA. Table 5 is showing Average Response Effect Each Factor, while table 6 is showing proposed composition. Table 7 is showing proposed composition experiment result, while Table 8 is showing composition company policy. And the last Table 9 is showing experiment result of company policy. In control experiments for each factor are two levels as follows:

Table 1. Controlled factors

Factors Control	Composition 1	Composition 2
Paint Composition	0.5 : 1	0.75 : 1
Distance Painting	15-20 cm	20-25 cm
Wind Pressure	50 Psi Fluid tip Round 1.8 mm ± 50 minutes	60 Psi Fluid tip Round 2 mm
Temperature	with a temperature of 50°C	± 50 minutes with a temperature of 60°C
Sanding Sealer	20-25 cm	15-20 cm
Topcoat Clear	20-25 cm	15-20 cm

As for the uncontrollable factor is as follows:

Table 2. Factors not controlled

Factor Not Controlled	Level	
	1	2
Working time	Morning	Noon
Physical and biological workers	Dedication	Extras
Environment	Comfort	Crowded

Table 3. The results of calculation of the average number of squares

Source of variation	Df	Sum of Squares (SS)	Mean of Squares (MS)
A	1	20	20
B	1	16.78	16.78
C	1	16.78	16.78
D	1	37.03	37.03
E	1	56.18	56.18
F	1	18.37	18.37
AB	1	17.95	17.95
BC	1	15.32	15.32
CD	1	16.78	16.78
DE	1	20	20
EF	1	18.37	18.37
E	18	100.17	5.56
SS _t	29	344	11.86

Incorporating factor starting from the number of the least squares of insignificant factor combined with the number of errors. The incorporation of an insignificant factor to these errors will result ANOVA table structure as follows:

Table 4. First Pooling Effect Factor ANOVA

Factor	Df	SS	M	SS	P	F.
A	1	20	20	14.	5.8	3.59
B	1	16.	16.	11.	4.8	3.01
C	1	16.	16.	11.	4.8	3.01
D	1	37.	37.	31.	10.	6.66
E	1	56.	56.	50.	16.	10.1
F	1	18.	18.	12.	5.3	3.30
AB	1	17.	17.	12.	5.2	3.22
BC	1	15.	15.	9.7	4.5	2.75
CD	1	16.	16.	11.	4.8	3.01
DE	1	20	20	14.	5.8	3.59
EF	1	18.	18.	12.	5.3	3.30
E	18	10	5.5			
SS _t	29	34	11.			

From the experimental results, controllable variables considered to be influence to the process of painting is the composition of paint used to compare the viscosity of

paint (A), the distance of the painting process (B), the wind pressure when painting process (C), the temperature used during the drying paint (D), sanding sealer when painting process (E) and a clear topcoat when painting process (F). The test results are as follows:

Table 5. Average response effect each factor

Factor	Level 1	Level 2	Diference	Rank
A	3.22	2.72	0.5	5
B	3.05	2.88	0.17	1
C	2.88	3.05	0.17	1
D	3.22	2.88	0.34	3
E	3.22	3.05	0.17	1
F	2.83	3.11	0.28	2
AB	2.27	3.16	0.89	6
BC	2.83	3.00	0.17	1
CD	2.88	3.05	0.17	1
DE	3.22	2.72	0.45	4
EF	3.11	2.83	0.28	2

After doing confirmation experiments to prove that the results are in accordance with previous experimental results. The experiments were conducted for 4 times, the first experiment uses set proposal as follows:

Table 6. Proposed composition

Level control	Factors
Paint composition	A2
Painting distance	B2
Wind pressure	C1
temperature	D2
Sanding sealer	E2
Topcoat clear	F1

The results of experiments using proposal composition as follows:

Based on the average of each factor and the calculated level can be explained most optimum level for defective product as follows:

Table 7. Proposed composition experiment results

Control factor	Code	N Experiment	Defective paint Unit	% Unit
Paint Composition	A2	19	2	10.52
Painting distance	B2	19	2	10.52
Wind pressure	C1	19	1	5.26
temperature	D2	19	1	5.26
Sanding Sealer	E2	19	2	10.52
Topcoat clear	F1	19	2	10.52
Total			10	56.60
Average			1.67	8,76
Sd			0.5163	

The experiment using factor level of company policy is as follows:

Table 8. Composition of company policy

Control factor	Level
Paint Composition	A1
Painting distance	B1
Wind pressure	C2
temperature	D1
Sanding sealer	E1
Top coat clear	F2

The experimental results using the composition of the company's policy as follows:

Table 9. Experiment results of company policy

Control factor	Code	N Experiment	Defective Product Unit	% Unit
Paint Composition	A1	19	4	21.05
Painting Distance	B1	19	4	21.05
Wind Pressure	C2	19	3	15.78
temperature	D1	19	5	26.31
Sanding sealer	E1	19	3	15.78
Top coat clear	F2	19	3	15.78
Total			22	115.75
Average			3.67	19.29
Sd			0.8164	

3.2. Discussion

Based on the validation test is known that early experimental results that do not differ from the results of experimental confirmation. Loss function both composition proposal and company policies are shown in Figure 1 and 2. Loss costs as shown in the graph loss function for defective product, the proposed parameter with an average value of 1.67 and Ly 122,979.85 shown on the chart shown below:

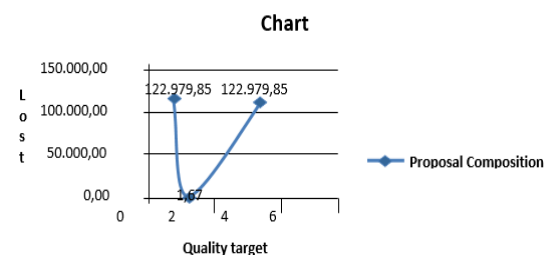


Figure 1 Loss function of composition proposal chart

While the loss function charts for defective products of company policy parameters with the average value of 3:00 and Ly 416,264, - is shown in the figure below:

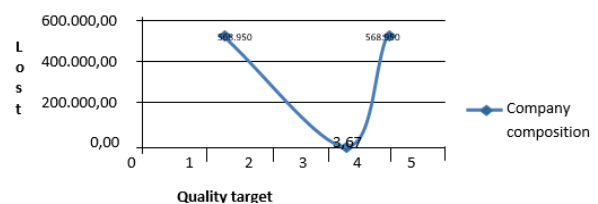


Figure 2 Lost function of company policies chart

4. CONCLUSION

Based on the results of research and discussion, the following conclusions can be : Level factor that has significant contribution to the percentage of a defective product, are factor level of paint composition at B2 level, factor level of painting distance at B2 level, factor level of air pressure at C1 level, air temperature at D2 level, sanding Sealer at E2 level and clear coat top at F1 level. Sensitive parameters that affect the quality of the painting are the composition of paint, painting distance, air pressure, temperature, sanding sealer and top coat clear. Setting the parameters proposed by the research can reduce defects percentage from 19.29% to 8.76%.

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