

**AN OPTIMIZATION OF TIN PLATING PROCESS USING  
DESIGN OF EXPERIMENT**

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AN OPTIMIZATION OF TIN PLATING PROCESS USING DESIGN OF  
EXPERIMENT

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## ABSTRACT

This research was done to reduce the variation of coating weight in Tin plating process. The objective of this research is to find the optimum setting in tin plating process. Design of Experiment was used to analyze various combination of process parameters. The process parameters investigated were Speed, Temperature, Sodium Ferrocyanide and Mole ratio fluoride to total stannous. It was not economically practical to run experiments in the real life factory environment as such historical data was used in this study. The historical data were selected to match the  $2^4$  full factorial of design matrix. Any missing data were treated by using regression method. The study reveals that the optimum setting is the high value (+1) of Speed, Sodium Ferrocyanide and Mole ratio fluoride to total stannous. Mathematical model is proposed to predict the performance of plating process with coating weight as the response. The model is valid within the investigated ranges and other experiments were conducted to analyze the characteristics of tin plate. The experiments are surface roughness test, surface topography, and cross section analysis. There are a few suggestions and suitable action plan were proposed to increase the quality of production.

## ABSTRAK

Kajian ini dijalankan untuk mengurangkan variasi ke atas ketebalan salutan di dalam proses menghasilkan plat tin. Objektif utama kajian ini adalah untuk mencari pemboleh ubah yang optima dalam proses ini. Rekabentuk Eksperimen telah digunakan untuk menganalisa pelbagai gabungan pemboleh ubah dalam proses ini. Pemboleh ubah yang dikaji adalah halaju, suhu, Sodium Ferrocynide dan nisbah mol fluorida kepada jumlah keseluruhan stannous. Tidak praktikal dari segi ekonomi untuk menjalankan eksperimen sebenar seperti di kilang melainkan data sejarah digunakan. Data sejarah dipilih untuk dipadankan didalam matrik rekabentuk kepada  $2^4$  faktorial penuh. Data yang hilang dirawat menggunakan kaedah regrasi. Hasil daripada kajian ini, pemboleh ubah yang optima adalah nilai tinggi (+1) pada halaju, Sodium Ferrocynide dan nisbah mol fluorida kepada jumlah keseluruhan stannous. Matematik model dicadangkan untuk mengaanggar keupayaan proses penghasilan plat tin dengan menggunakan berat saduran sebagai respon. Model in sah di dalam kumpulan nilai yang dikaji dan beberapa eksperimen telah dijalankan untuk menganalisa karakter pada plat tin. Eksperimen- eksperimen tersebut adalah mengukur kekasaran permukaan, taburan saduran dipermukaan dan analisa pemotongan tengah. Beberapa cadangan telah dikemukakan untuk meningkatkan kualiti pengeluaran

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background of The Project**

In general, Design of Experiment is applicable to any situation that depends on many factors such as variables, inputs or parameters. It is a technique to define the best option when having many possibilities. When many factors influence an outcome, the testing of one factor at a time cannot be used. Experiences has shown .that the results from other researchers by testing one factor at a time often do not true when all factors are in the same action in real application. All kind of industries can apply Design of Experiment when they involve in products and processes optimization. Design of Experiment can produce maximum return when applied in research, concept design and product development. The quality of process such as machining, heat treating, casting, molding and coating are attributed to a number of factors. The significance of the process parameter can be determined by proper application of experimental design.

This project also looks into some other characteristics. They are surface roughness and hardness of tinplate. Surface roughnesses are measured before the raw plate called Tin Mill Black Plate (TMBP) being plated through electroplating. The company believed that the surface finish was influenced by

the raw material of plate (TMBP). That's why the surface roughness of TMBP was measured before the electroplating. Surface roughness was in accepted range which is in specification. Surface roughness will be ignored in this project because it was found not influence by the plating process.

While for the hardness, the desire hardness was ordered from the TMBP supplier according to the customer requirement. The hardness of the tinplate was measured after finish all processes. Hardness from supplier compared to the laboratory test which found that the hardness was in specification. The hardness are same before and after electroplating processes. From this reason, this characteristic is not the one of quality characteristic to be measured. The hardness is requested by customer due to the application of tinplate.

This study will review on plating process. Some data will be taken from the company to characterize the existing condition and formulate the problem. The experiment plan will be developed and the experiment will be conducted. The result from the experiment are then being analyze and the conformation run will be run by using optimum parameter setting.

## **1.2 Problem Statement**

Tin plating process is the most effective way of protecting the base material against environment or improving surface properties of base material. However in electroplating industry, insufficient coating characteristics are the common problem faced such as pin holes, surface roughness, variation in coating thickness and so on.

There is too much variability of coating weight in plating process. The coating weights are much higher than desire. Currently, the parameters are being set based on trial and error. So, this study will try to find the optimum setting parameters that influence the accuracy and precision of coating weight.

### **1.3 Objectives:**

The objectives of this study are:

- i. To identify the problem in a Tin plating process.
- ii. To study process parameters and their influences on the coating characteristics.
- iii. To obtain an optimal setting of process parameter for coating performance.

### **1.4 Scope:**

The scopes of this study are:

- i. This study focus on Tin plating process of in Perstima Berhad.
- ii. Only coating weight will be studied as the quality response.
- iii. Only product of 2.8/2.8 g/m<sup>2</sup> will be studied.
- iv. The Classical Design of Experiment is employed.

### **1.5 Methodology**

The project methodology is based on several steps that allow the project to be done systematically. Begin with the characterization of existing process and then plan the experimental design. After that, the experiment was conducted by using statistical method where were discussed in chapter 3.

## **1.6 Expected Result**

The DOE approach may eliminate or reduce the problems faced by electro-platers and provide detailed information about the interaction between process parameters. Thus, the values of process parameters can be arranged according to the desired characteristics.

The statistical design approach gives an opportunity to fully understand the effects of process parameters on coating weight by performing significantly fewer experiments than if one factor at a time had been evaluated. A good understanding of how interactions among the various factors influence the coating weight of plated specimens was obtained. Again, this information would not have been obtained if one factor at a time had been investigated. Accurate relationships, describing the effects of the various factors on coating weight, were obtained by using statistical design approach. The aim of this project is to improve the quality of product by reducing the variation of coating weight. When the performance is constantly closer to the target, fewer products are produced out of target. Meaning that, products are produced within specification limit or in this case study products are within Guaranty Limit.

## **1.7 Summary**

This chapter has observed the problem in the company selected, Perstima Berhad. The variability of coating weight has been found in the company. Then the objective and scope are determined. The target of this project is to reduce the variability by investigating optimum parameter setting.

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