Faculty of Technology Management & Technopreneurship

ID DEFECT MINIMIZATION IN GLASS SUBSTRATE INDUSTRY

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MBA in Advance Operation Management

2013

ID DEFECT MINIMIZATION IN GLASS SUBSTRATE INDUSTRY

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A thesis submitted in fulfillment of the requirements for the degree of
Master of Business Administration in Advance Operation Management

Faculty Of Technology Management and Technopreneurship

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2013

DECLARATION

"I declare that this project paper entitle **ID Defect Minimization in Glass Substrate Industry** is the results of my own research except as cited in the references. The project paper has not been accepted for any degree and is not concurrently submitted in candidature of any other degree".

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APPROVAL

I hereby confirm that I have examined this project paper entitled:-

"ID DEFECT MINIMIZATION IN GLASS SUBSTRATE MANUFACTURING"

By

NORSHAZWANA AKMAL BINTI HANAFI

I hereby acknowledge that this project paper has been accepted as part

Fulfillment for the degree of Master of Business Administration

.....

Prof Dr Salleh Bin Yahya

Supervisor

DEDICATION

My lovely parents for their endless love, support and encouragement

My handsome brothers for their care, courage and fun times together

My beautiful friends for their understanding and knowledge sharing

Thank You for Everything

ACKNOWLEDGEMENT

In the name of Allah, most gracious, most merciful. With the highest praise to Allah that give me the blessing and courage to complete this project. First and foremost, I would like to thank my parents for their love and support throughout my life. Thank you for giving me strength to reach the starts and chase my dream.

I would like to sincerely thank my dedicated supervisor, Professor Dr. Salleh bin Yahya, for his assistance, guidance, and inspiration throughout the completion of this project. Also, for all lecturers who had deliver the knowledge and experience throughout my MBA courses.

To all my friends, thank you for your understanding and encouragement in my difficult times. Your friendship makes my life wonderful.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPH

ABSTRACT

This study is mainly about the ID defect reduction project in glass substrate manufacturing industry. By using quality tools, lean manufacturing approach, and total quality management, defect can be reduce by controlling on 4 variables: data variance in SPC, measurement tools accuracy, machine stability and operator skills. Based on these four variables, operator skills have higher tendency on defect generation in glass substrate manufacturing if compared to others. Thus, company should focus on the enhancement activity to lift up operator skills and motivation in order to reduce the defect rate.

Keywords : Defect Reduction, Human Error, Process Control

Paper Type : Research Paper

CHAPTER ONE

INTRODUCTION

1.1 Background

As the world is moving from manual system to computational system, people no longer depend on paper to keep the data since everything is stored in the computer. It is estimated that over 90% of all new information produced in the world is being stored on magnetic media, most of it on hard disk drive (HDD). Apart from well-known use in notebook and computers, hard disk drives are also found in car navigation systems, tablet, digital video cameras and portable hard disk drive itself.

Hard disk drive has been all essential part in the storage and access of data. As the hard drive consists of data that is accessed at high speeds, there needs to be a mechanism that complements fast access speeds. There are seven components that make this possible, which are the enclosure, spindle, platter, motor, actuator arm, interface and logic board (Hallock, 2007). From those seven components, there are three main components which are essential for hard disk drive which are platter, spindle and arm. The most important part of hard disk drive is its platter. Platter is a circular surface which consists of sectors where the data gets store. The platters are placed on top of the other with a spindle in the centre that hold them together and is responsible for its rotation. Susan (2011) describe that the spindle is the component responsible for rotation of the platter and responsible for placing the appropriate sector of actuator arm. This arm is responsible for accessing the data from platters by using a mechanism of electrical discharge.

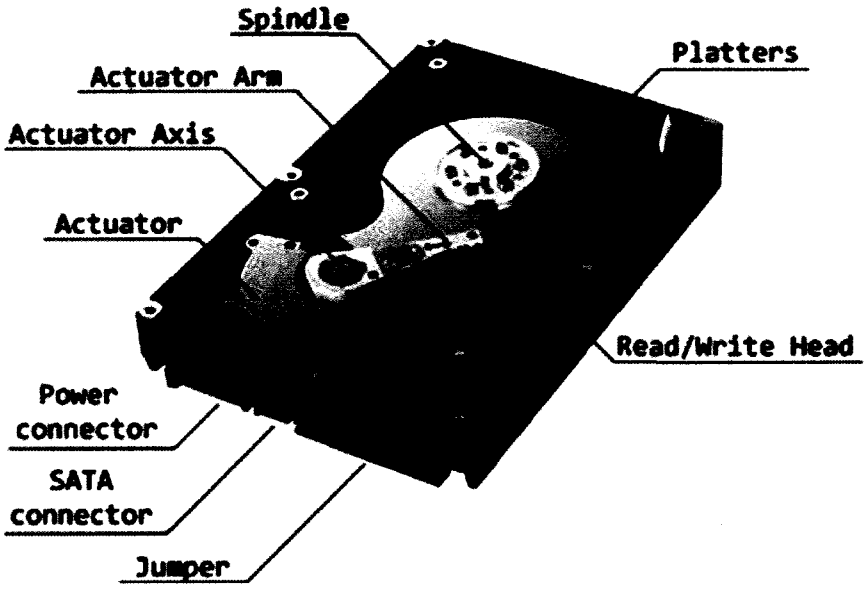

Figure 1.1: The internal part of hard disk drive

Like videotape and floppy disks, hard disks are magnetic media. Magnetic impulse with either positive or negative polarities represent the data stored on the magnetic layer of a hard disk's round, rigid platters. As the data is stored in a very thin media layer on the surface of platter, the platter themselves are probably the most important and complicated component. The platter inside a hard disk drive is a polished magnetic material on the surface that makes the platter appear shiny, like a mirror and a clean, polished surface is critical to the proper functioning of the hard drive (Katharine, 2012). Normally platter is made up from a thin disk of aluminium or glass substrate which coated with an ultra-thin layer of cobalt alloy. However, manufacturer's desire for higher and higher density and smaller drives has led to the used of platters made of glass. As stated in Data Recovery Link's Website (retrieved 19 Dec 2012), platter that made up from aluminium is rigid, lightweight, inexpensive, easy to work with, readily available, magnetically inert and stable.

Although aluminium based platter seems perfect for hard disk drive production, glass substrate platter have several advantages over aluminium platter. The main concern of glass substrate platters is it gives better quality by improving the dependability of the hard disk drive and increase spindle speed. Besides, glass will enhance the rigidity of hard disk drive which will drop the noise levels and vibration in the drives that spin at high speed. With the enhance rigidity platters can be made thinner than aluminium. Thinner platters weigh less which means reduced spindle motor requirements, reduced start time when the drive is at rest and it also allows an increased number of platters to be placed into the same size hard drive. Compared with aluminium, glass substrate excels in heat resistance and shockproof, and is much more suitable for higher density storage media. Thus, there are no offences that nowadays more manufacture of platter move from aluminium based to glass substrate based of platter.

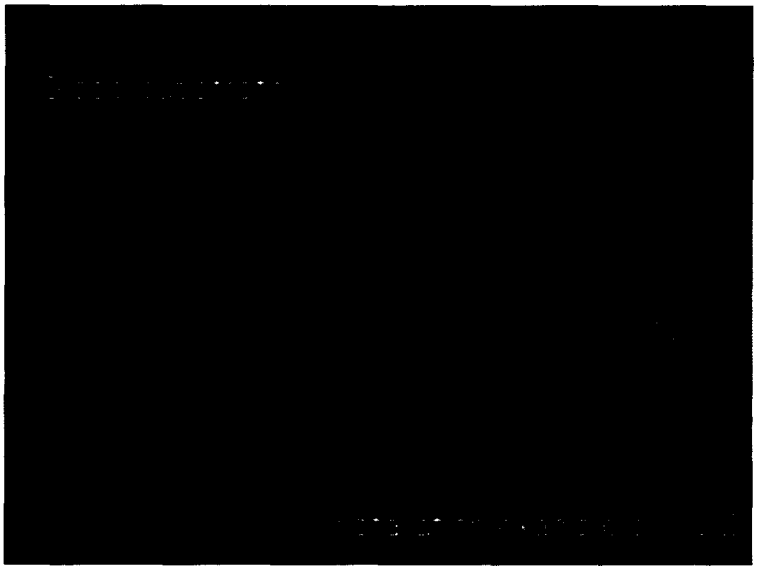

Figure 1.2: The glass substrate based platter

In view of the growing demand for personal computers, it gives great potential for hard disk drive market to growth rapidly as well as given great reflections for potential growth of glass substrate industry. Glass substrate is mostly monopoly by company from Japan which applies high technology knowledge and adopted high precision machine through their manufacturing process. Manufacturer of glass substrate have developed a process for high-precision glass materials, which takes advantage of optical fibre manufacturing technologies. Glass substrates are disks made of plain glass plates. They need to undergo many processes before end up as a storage media. Glass plates are round, polished and coated with magnetic materials for use as magnetic disks incorporated in hard disk drive.

As a raw material, glass substrate comes in a form of blank disk which need to be processes under certain condition and specification. Figure 1.3 show the process flow for glass substrate:

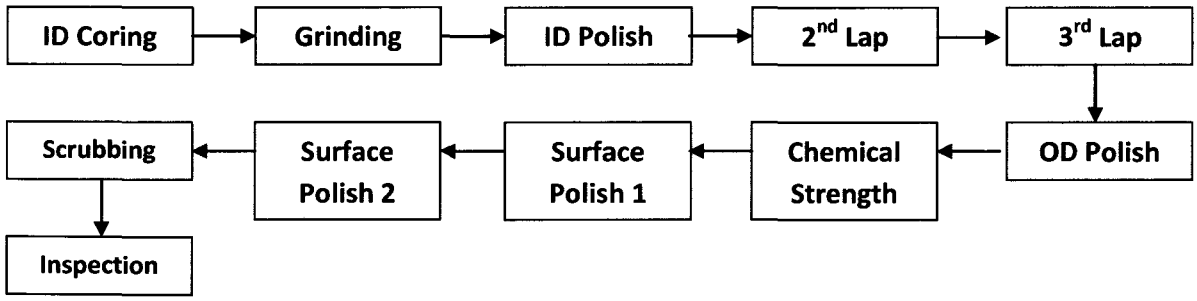

Figure 1.3 : Process Flow in Glass Substrate Manufacturing

Based on the process flow above, it shows that the glass substrate move from shaping process to polishing process. Basically, the shaping process takes part in the earlier stage of production, which includes ID Coring and Grinding. In general, shaping meant given a specific shape in term of inner diameter (ID) and outer diameter (OD) which chamfering the disc in certain angle and specific size requested by customer. After shaping process, the inner part and outer part of the disc will be polish under ID polish process and OD Polish process. Both of these processes will give a better effect to the ID and OD part of the disk. The controls parameters in these processes are very thigh as it will affect the media during assemble it in the platter slot. Continuously, once finish the shaping process the disk will undergo polishing process which polish their surface. This is the most important part in glass substrate industry as all the data will be stored on this surface. Thus, even a single scratch on the surface will lead to failure of hard disk drive.

1.2 Problem Statement

As data is stored on the surface of glass substrate, many studies have been conducted on glass substrate focusing on how to enhance its capability and capacity, but up until now, there are only few or no study conducted to enhance the ID shaping process. Instead of focusing on the disc surface alone, shaping process of Inner Diameter (ID) is also important in glass substrate production. Throughout glass substrate process flow, ID Polish is the only department that were responsible to taking care of glass substrate inner diameter condition, which include the smoothness of ID chamfer surface, ID size, and ID quality. Based on November 2012 Pareto Diagram, ID defect is classify into 7 categories which are ID out of spec, ID Kan, Inner Kake, Outer Kake, Ware, Chipping and Surface Kan.

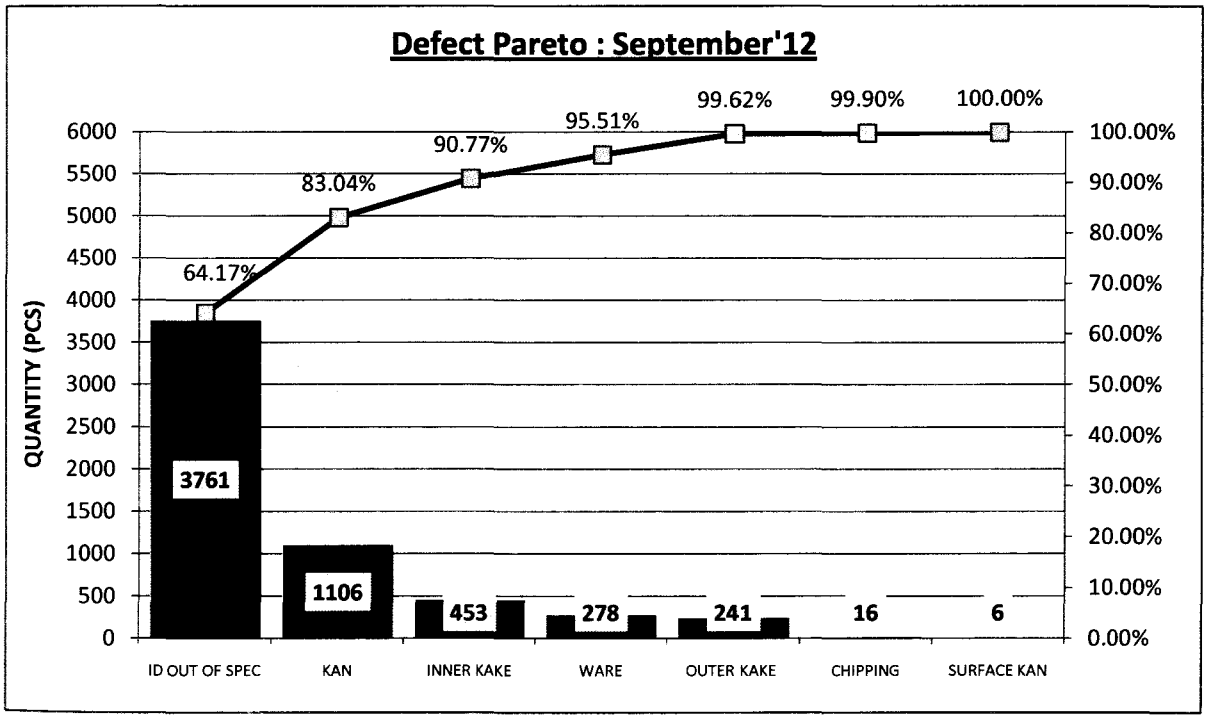

Figure 1.4: Defect Pareto for the month of September'12

Reflected from September'12 Defect Pareto, ID out of spec is the main contribution for ID defect in ID polish process. In glass substrate manufacturing process, ID out of spec is classify as ID size out of control range, which is ID small size or ID big size. Both of these defects will lead to failure in hard disk drive as it will affect the rotation of spindle in drive case. Once the defect is detected at ID Polish process, the glass material will be dispose, and it will reduce the productivity, profit and performance of the company.

In fact, high disposal rate reflects to the looseness of process control itself. Thus, it is important for the process engineer to ensure those things can be eliminate. Besides, the concept of "prevention is better than cure" should be applied here. It is important to take preventive action to prevent those defect from occurs, rather than cure the defect.

1.3 Research Objectives

There are many problem related to inner diameter (ID) of glass substrate, which are inner diameter out of spec, inner diameter contamination (have dented particle) at chamfer side, and other defect like chipping, Kan, Ware, and crack. Other issue were related to more technical matter, but ID Size out of spec is depends on measurement tools accuracy and human control.

Thus, this study is purposely done to get a clear perspective on inner diameter defect in glass substrate manufacturing and propose a perfect solution for manufacturer to overcome this issue as well as to reduce raw material loses. Hence, the **main objective** of this study is to minimize the number of ID defect of product by control of process variables that affect the quality of product. Another objective is to enhance the Defect Cycle introduced by Nasreddin et al (2005) that consist of:

- Classification and Identification of the source of inner diameter defect in glass substrate manufacturing
- Analysis of defect probability
- Statistical Measurement of quality
- Lean Manufacturing tools to prevent the presence of defect on the product.

1.4 Research Questions

i. What are the highest contribution factors for inner diameter defect?

ii. How Lean Manufacturing tools can prevent the presence of ID defect?

iii. To what extent of human control that can enhance the effectiveness of ID quality?

1.5 Significant of the Research

For instance, this study will provide relevant finding to the affect of defect reduction in term of productivity and quality improvement. This study will be done in one of the glass substrate factory in Malaysia, which produces about 11 million pieces of glass substrate per month. The defect reductions have a relationship between human controls and process control itself.

Defect is a reflection of lost. Once the defect is dispose, its mean company is reducing the profit. Therefore, it is crucial for company to control and minimize defect as it will improve company performance in term of profitability and productivity. The study also will contribute to defect reduction literature especially the literature on the relationship between process control and human control with the productivity performance or yield. For this purpose, the main literature will adopt from Nasreddin et al (2005) study, which study about defect cycle and the development of methodology for quality improvement in manufacturing organizations. In addition, this study will help glass substrate industry to improve their control on defect management.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Nowadays, many businesses don't think in terms of minimizing defects, rather they talk about solving problems (Duncan, 2006). In many company, defect is consider as lost. Ya-Hui (2011) says that any appearance of defect may degrade the value of the product. In fact, products degrade and product lost is projected through company performance and profitability.

Thus, this chapter will reviews the literature on concept of defect, defect life cycle, source of defect, tools for early defect detection, as well as lean manufacturing tool to prevent the presence of defect on the product.

2.2 Defect Definition

Defect is a mark or flaw that spoils the appearance of product. On the other hands, defect is considered as an imperfection in an object or product. Thus, defect is a deviation from specification or, in other words, the performance gap between a desired result and an observed result (Nasreddin, 2005). In glass substrate manufacturing process, inner diameter defect (ID Defect) is considered as a mark that spoils the appearance of media at inner diameter side which located at inner diameter chamfer (ID C-men) and inner diameter surface (ID S-men). There are many classification of inner diameter defect depending on the type, size, and location of the defect.

Referring to BusinessDictionary.com, manufacturing defect is consider as frailty or shortcoming in a product resulting from a departure from its design specification during production. Besides, these types of defect are the direct result of manufacturers' error in the making or assembling of their products. A defect in manufacturing is one of the manufacturer did not intended to do. The error mostly comes from machine, tools and human itself.

In Six Sigma, defect is defined as any process output that does not meet customer specifications, or that could lead to creating an output that does not meet customer expectations (Lin 2013 and Sebastian 2012). The philosophy of Six Sigma is to keep a process within its limits so almost no defect occurs. All defects recorded as non-conforming will influence customer satisfaction and significantly increase the losses incurred during implementation of corrective actions as well as losses caused by a drop in sales. Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defect and minimizing variability in manufacturing process.

Similarly, in term of Lean Manufacturing, defect is considered as one out of seven wastes which fall under waste of defective goods (Andrew, 2009). Defect is classified as waste because total cost of poor quality can be very high and will include scrap material, wasted labour time and time expediting order and loss of goodwill through miss or delay delivery dates. All of this attribute will lead to unproductive and inefficient of the organization. The costs of rejects are often compared to an iceberg theory, which is only a small fraction of the true cost being visible above the water level. On the other hand, instead of the obvious cost of initial scrap items, there are numbers of other cost that are hidden. Defect can be caused by many different problems, many that should be avoidable with a little though when designing the products, process and equipment itself.