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To implement new standard of after cure tire for motorcycle tire

ชื่อนิสิต นางสาวอาทิมา ไหลรัตนกุล **เลขประจำตัว** 5933113023

ภาควิชา เคมี

ปีการศึกษา 2562

คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

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โดย

นางสาวอาทิมา ไหลรัตนกุล

รายงานนี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตร

ปริญญาวิทยาศาสตรบัณฑิต

ภาควิชาเคมี คณะวิทยาศาสตร์

จุฬาลงกรณ์มหาวิทยาลัย

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Project Title To implement new standard of after cure tire for motorcycle tire

By Ms. Artima Lairattanakul

Accepted by the Faculty of Science, Chulalongkorn University in Partial Fulfillment of the Requirements for the Bachelor Degree

SENIOR PROJECT COMMITTEE

1. Professor Thawatchai Tuntulani, Ph.D. Chairman
2. Assistant Professor Nawaporn Vinayavekhin, Ph.D. Examiner
3. Associate Professor Nuanphun Chantarasiri, Ph.D. Project Advisor
4. Ms. Jittiporn Thanakitworawat Special Co-Project Advisor

This report was approved by head of Department of Chemistry

.....

(Assistant Professor Nuanphun Chantarasiri, Ph.D.)

Project Advisor

.....

(Ms. Jittiporn Thanakitworawat)

Special Co-Project Advisor

.....

(Associate Professor Vudhichai Parasuk, Ph.D.)

Head of Department of Chemistry

Date 19 Month December Year 2019

ชื่อโครงการ การประยุกต์การจัดเกรดยางหลังอบสำหรับยางรถจักรยานยนต์
ชื่อนิสิตในโครงการ นางสาวอาทิมา ไหลรัตนกุล เลขประจำตัว 5933113023
ชื่ออาจารย์ที่ปรึกษา รองศาสตราจารย์ ดร. นวลพรรณ จันทรศิริ
ภาควิชาเคมี คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ปีการศึกษา 2562

บทคัดย่อ

การศึกษามาตรฐานการจัดเกรดยางรถจักรยานยนต์ (เอฟทีพี, FTP) ฉบับใหม่รวมไปถึงเตรียมความพร้อมของพนักงานจัดเกรดยางนั้นเป็นสิ่งที่จำเป็นก่อนนำเอฟทีพีฉบับใหม่ไปใช้ทดแทนฉบับปัจจุบัน จากเหตุผลข้างต้น การเปรียบเทียบข้อแตกต่างระหว่างเอฟทีพีฉบับปัจจุบันและฉบับใหม่ การเก็บรวบรวมข้อมูลเพื่อปรับปรุงเอฟทีพีฉบับใหม่ เพื่อเตรียมพร้อมสำหรับการใช้ในสถานการณ์จริง และการจัดการอบรมพนักงานจัดเกรดยางเกี่ยวกับเอฟทีพีฉบับใหม่ภายหลังได้รับการปรับปรุงเรียบร้อยแล้วเพื่อให้พนักงานเกิดความเข้าใจและสามารถใช้เอฟทีพีฉบับใหม่ได้อย่างถูกต้อง จึงเกิดขึ้น ผลของการดำเนินการตามขั้นตอนเหล่านี้คือ มีการเพิ่มหมวดหมู่กลุ่มความผิดปกติของยาง (ซีคิว, CQ) ในเอฟทีพีฉบับใหม่ นอกจากนี้ ได้ปรับปรุงขอบเขตของค่าที่ใช้ในการพิจารณาแผลของยาง เนื่องจากมีการพัฒนาของวิธีการซ่อมและประสบการณ์ของเจ้าที่ผู้ทำการซ่อมยาง ซึ่งการจัดเกรดยางรถจักรยานยนต์โดยใช้เอฟทีพีฉบับใหม่สามารถได้ปริมาณยางที่ผ่านเกณฑ์มากขึ้นโดยรวมถึงร้อยละ 8 เมื่อเทียบกับฉบับปัจจุบัน และจากขั้นตอนการอบรมพนักงานจัดเกรดยางโดยใช้เอฟทีพีฉบับใหม่พบว่าสามารถจัดเกรดยางได้อย่างถูกต้อง

คำสำคัญ : มาตรฐานของยางรถจักรยานยนต์

Project Title To implement new standard of after cure tire for motorcycle tire

Student Name Ms. Artima Lairattanakul Student ID 5933113023

Advisor Name Associate Professor Nuanphun Chantarasiri, Ph.D.

Department of Chemistry, Faculty of Science, Chulalongkorn University, Academic Year 2019

Abstract

The study of the new standard for classifying the motorcycle tires (File Tolerance Product, FTP) including the preparation of the inspectors who classify the tires needs to be studied before implement the new FTP instead of current FTP. Due to this reason, the comparison between the current and new FTP, the collection of the details to adjust new FTP, the preparation for using in the real situation and the training of inspectors about completed new FTP which made the inspectors understood and could use completed new FTP correctly were done. The results of these processes are the addition of the defective tire groups (CQ) in new FTP and the updating of criteria which are used to determine the defect on tire because of the improvement of the rework instruction and the experience of rework operators. This makes the percentage of the gain tires from the classification result of new FTP increases equal to 8 as compared with the current FTP. The training of inspectors about using the new FTP shows that they can use new FTP correctly.

Keywords: motorcycle tire standard

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Finally, I most gratefully acknowledge my parents and my friends for all their support throughout the period of this research.

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LIST OF ABBREVIATIONS AND DEFINITIONS

Barcode	A thing which is used to indicate each tire and used to record data in factory record system.
Completed new FTP	The new FTP which is adjusted to be more suitable and confirmed by Michelin central.
CQ	The number which is the representative of a defect on a tire and used to lookup about classification criteria in FTP.
Criteria of FTP	The criteria of classifying defected tires consisting of good, rework and scrap.
Current FTP	The current version of FTP which is applied in the factory.
Defective group	The group of defect which is divided by the defect that represent on the tire. In FTP called “CQ”.
Defective tires	The tires that have the defect on its body.
FTP	FTP is File Tolerance Product which is a standard to classify the after cure tires.
Gain tires	The suspect tires which is classified by expert team that they can be reworked.
New FTP	The FTP which is updated from the Michelin central to apply in the factory instead of the current version of FTP
Non-conform tires	The defected tires which is over good tires limit of the FTP criteria.
Scrap tires	The tires which are in or over the scrap criteria limit of the FTP.
Suspect tires	Non-conform tires that will classify final time at classify post by an expert team to collect data and discuss it with Michelin central.
Updated new FTP	The new FTP which is updated by the analyzed data which is discuss in the factory.

Chapter 1

Introduction

1.1 Michelin's History

SCA Compagnie Générale des Établissements Michelin or abbreviated as Michelin is a French tire manufacturer based in Clermont-Ferrand in the Auvergne-Rhône-Alpes region of France (Figure 1.1). It manufactures tires for cars, bicycles, space shuttles, aircraft, automobiles, heavy equipment and motorcycles [1]. The first priority of Michelin is promoting sustainable traffic. The technology center and production plants around the world of Michelin give priority to the balancing of tires in three main features, namely safety, fuel economy, and long service life for all types of cars to get the tires with complete specifications without losing any of their capabilities [2].

Michelin Thailand was founded in 1987 and consists of four factories which divide into three car tires factories and one bead manufacturing. These factories are under the operation of Michelin Siam Co., Ltd, Michelin Siam Co., Ltd (Phra Pradaeng) and Michelin Research Asia (Thailand) Co., Ltd. They have a total of 6,700 employees [2]. Michelin also has a Michelin guide which has the objective to help travelers during their trips. This idea comes from the grand vision of brothers Andre and Edouard Michelin (Figure 1.2). It represents the Michelin slogan "The better way forward" [3].

Figure 1.1 Michelin headquarters in Clermont-Ferrand [1]

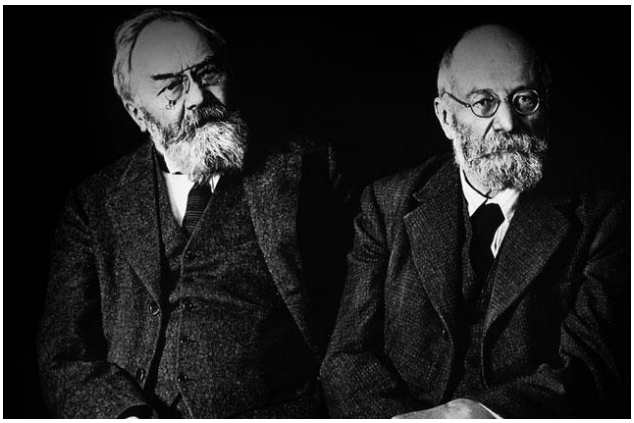


Figure 1.2 The brothers Andre and Edouard Michelin [4]

1.2 The overview process of Michelin Phra Pradaeng factory

In Michelin Phra Pradaeng factory, the process is divided into eight sections as shown in Figure 1.3 The details of each section are described as follows:

1.2.1 Raw materials (RM) section

The raw materials section provides ingredients such as rubbers and chemicals to prepare the compound of the tire component.

1.2.2 Mixing section

Mixing section mixes compounds in a specific ratio to produce the mixture of tire components.

1.2.3 Preparation section

Preparation section gets the mixture to figure them in shape that can be used to build tires.

1.2.4 Tire building machine (TBM) section

Tire building machine section gets the components from preparation section to produce uncured tires by laying up the components on tire building machines in the specific position.

1.2.5 Curing section

Curing section uses mold and curing press with the specific temperature, pressure and time to vulcanize the tires.

1.2.6 Final inspection section

Final inspection section checks after cure tires to control their quality by manual inspection and automatic machine. The standard used is called File Tolerance Product (FTP).

1.2.7 Warehouse section

Warehouse section is the place that is used to store tires before delivery to the customers.

1.2.8 Quality Guarantee Product (QGP) section

Quality Guarantee Product (QGP) section checks the quality of tires by sampling in each process to control the quality of them.

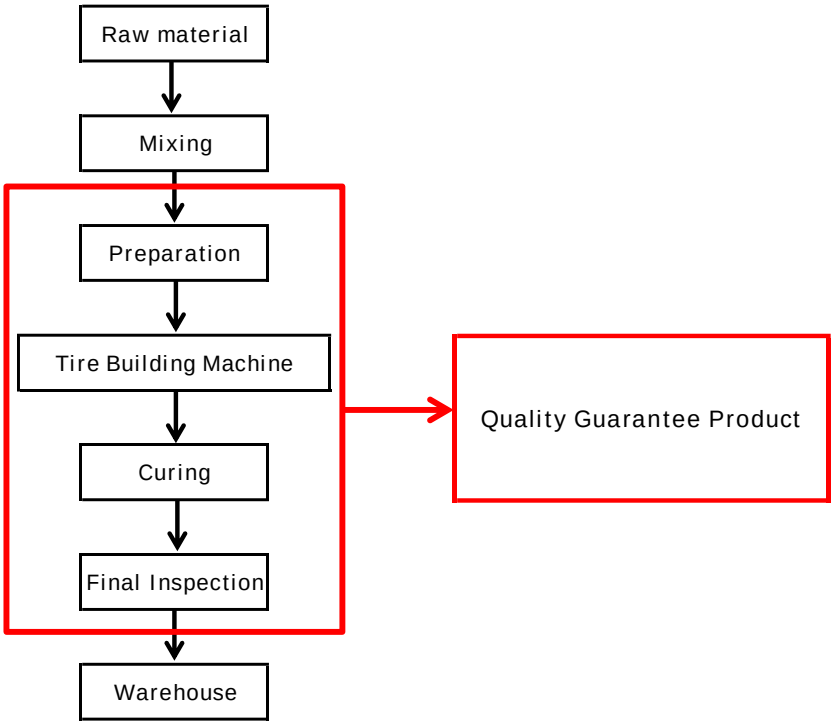


Figure 1.3 Overview process of Michelin Phra Pradaeng

1.3 The origin of the project

Due to the Michelin central in France realizes about the high competition of the motorcycle tires in the present market, so the Michelin central updates the current File Tolerance Product (FTP) which is used to classify the defect of after cure tires to be more up-to-date and adds the group of criteria which is used to classify the tires in current FTP to respond to the customer satisfaction and to compete in the quality in the present market. The updated version of the current FTP called new FTP is sent to all of the factory subordinated to Michelin which produced the motorcycle tires and Michelin Phra Pradaeng is one of them. For all of these details, The study of new FTP and the inspectors training about new FTP are required to prepare for the implementation of new FTP.

1.4 Objectives and scope of the project

1.4.1 Objectives

1) To study the differences between the current FTP and new FTP in terms of their criteria and suitability of methods for classifying the tires.

2) To study and analyze the extended scope of new FTP.

3) To define the solution when the problems are found in new FTP and give information to the team immediately.

1.4.2 Scope of the project

Study about the new FTP before implementing in the factory from 3 June to 31 October 2019.

1.5 Theory and literature reviews

1.5.1 Definition of quality

Quality is one of the most important factors for consumer decisions among competing products and services. Although the consumers have their lifestyles or passions, the development of quality is an important key factor which leads to business success, growth and enhanced competitiveness. It is one of the impact business strategies that give a substantial return on investment and the success of the overall business [5].

1.5.2 Statistical process control (SPC)

Statistical process control (SPC) is one of the current useful tools that is used to control the quality precisely because it gives small variability around the target or dimensions of the product quality characteristics. Moreover, it is based on fundamental principles, is easy to use, has a significant impact and can be applied to any process. It consists of 7 major tools as follows:

1. Histogram
2. Check sheet
3. Pareto chart
4. Cause-and-effect diagram
5. Defect concentration diagram

6. Scatter diagram

7. Control chart

These tools are called "the magnificent seven", which relate to the usual process of business or organization and they are used to control quality improvement. Although the business or organization has its process, these seven tools can help them to achieve their quality improvement objectives systematically. In this report, only three tools used in this project will be described. These three tools are histogram, check sheet and Pareto chart [5].

1.5.2.1 Histogram

A histogram is a graph that represents the distribution of numerical data. Before creating a histogram for continuous data, the number of observations and the amount of data dispersion should be determined to define the number of class intervals. The range of class intervals are equal to enhance the visual of the information in a histogram. A histogram uses the horizontal axis to represent the topic of measurement and the vertical axis to represent the frequencies as shown in Figure 1.4 [5].

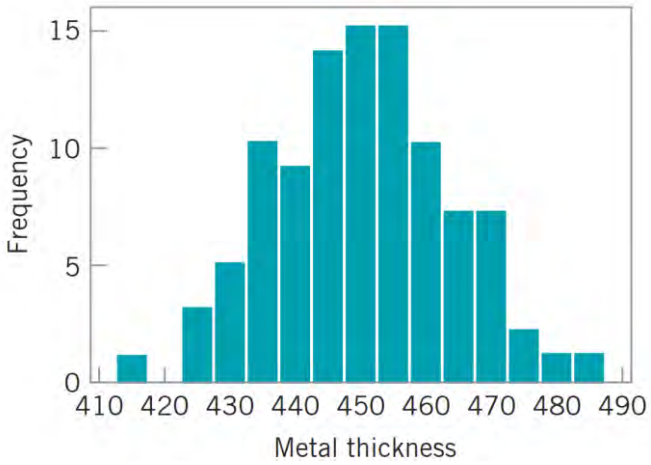


Figure 1.4 An example of a histogram [5]

1.5.2.2 Check sheet

The check sheet (Figure 1.5) is a document with a specific topic that is used to check the order of the processor that records the result of activity. It is a very useful tool for data collection; however, its topics should be carefully designed and arranged clearly and all necessary topics must be included. The process, which looks like a running trail or validate test, helps recheck before using in the activity [5]. Nowadays, electronic worksheets such as Microsoft Office Excel is used to collect the data. In a specific situation, computers and electronic gadgets cannot be used and therefore paper check sheet is still required. The combination of a paper checklist and electronic record is useful for the factory in many applications such as when the activity is followed up. The related people can check the data and follow up the process by checking the file and if there is any problem, the data can be quickly adjusted [5].

CHECK SHEET
DEFECT DATA FOR 2002–2003 YTD

Part No.: TAX-41
Location: Bellevue
Study Date: 6/5/03
Analyst: TCB

	2002												2003					
Defect	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	Total
Parts damaged		1		3	1	2		1		10	3		2	2	7	2		34
Machining problems			3	3				1	8		3		8	3				29
Supplied parts rusted			1	1		2	9											13
Masking insufficient		3	6	4	3	1												17
Misaligned weld	2																	2
Processing out of order	2															2		4
Wrong part issued		1						2										3
Unfinished fairing			3															3
Adhesive failure				1							1		2			1	1	6
Powdery alodine					1													1
Paint out of limits						1								1				2
Paint damaged by etching			1															1
Film on parts						3		1	1									5
Primer cans damaged								1										1
Voids in casting									1	1								2
Delaminated composite										2								2
Incorrect dimensions											13	7	13	1		1	1	36
Improper test procedure										1								1
Salt-spray failure													4			2		4
TOTAL	4	5	14	12	5	9	9	6	10	14	20	7	29	7	7	6	2	166

Figure 1.5 An example of a check sheet [5]

1.5.2.3 Pareto chart

Pareto chart is a histogram that shows the distribution of data in sequence. This chart helps the user to visually identify the most frequently occurring of data in the chart such as the tank defect data as shown in Figure 1.6.

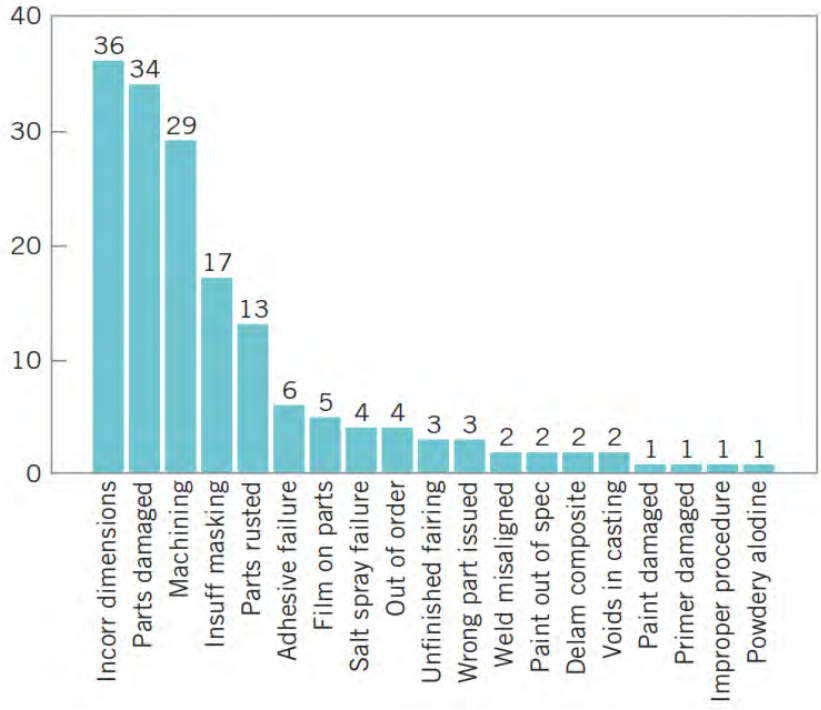


Figure 1.6 Pareto chart of the tank defect data [5]

Although a Pareto chart can be used to visualize the most frequently occurred defect, it cannot tell the most important defect which is caused by the large expenses. Therefore, the Pareto chart should be used in combination with other data to determine the significant defect which should be concentrated [5].

1.6 Manufacturing of motorcycle tire

The overall of motorcycle tire manufacturing process and tire manufacturing process are similar but in tire manufacturing process, some components are added as shown by number 13 and 14 which is represented in the Figure 1.7. The overall process of tire manufacturing process is shown in Figure 1.7. It consists of 5 main processes as follows:

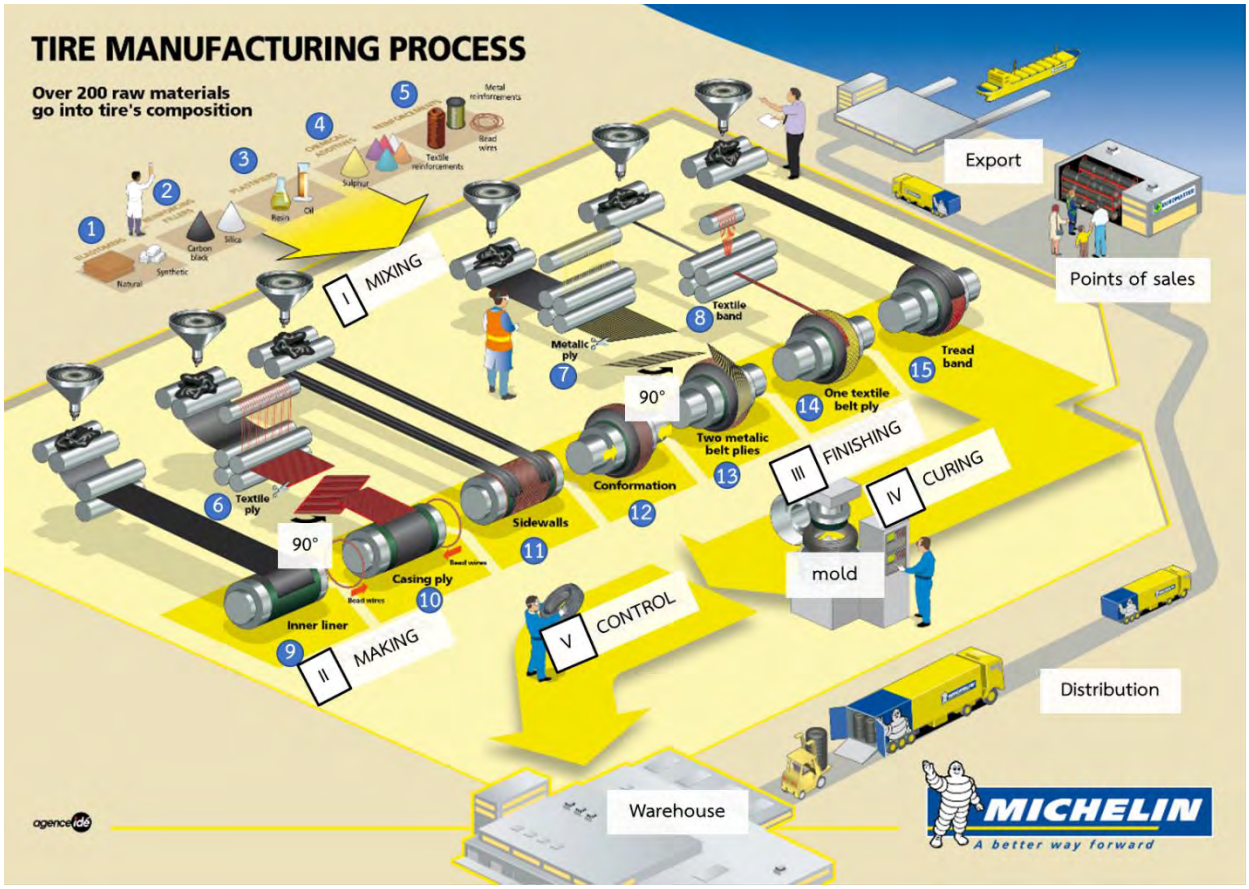
I MIXING

II MAKING

III FINISHING

IV CURING

V CONTROL



1. Elastomers: Natural and Synthetic
2. Reinforcing fillers: Carbon black and Silica
3. Plasticizer: Resin and Oil
4. Chemical additives: Sulphur
5. Reinforcements: Textiles reinforcements, Bead wires and Metal reinforcements
6. Textile ply
7. Metallic ply
8. Textile band
9. Inner liner
10. Casing ply: Bead wires
11. Sidewalls
12. Conformations
13. Two metallic belt plies
14. One textile belt ply
15. Tread band

Figure 1.7 The overall of tire manufacturing process [6]

1.6.1 The basic components in tire manufacturing

The basic components of tire manufacturing are shown in Figure 1.8

Figure 1.8 The basic components for tire manufacturing [7]

1.6.2 Production and preparation of semi-finished products

The production called mixing process, which produces the rubber mixture that has the natural and synthetic rubbers as basic components and then add the special materials depending on the purpose of tire. After that, the rubber mixtures are sprayed, rolled and cut with the special machinery to make the parts of tire components [7].

1.6.3 The green tire

The non-vulcanized tire which is ready to vulcanize called green tire as shown in Figure 1.9 is built by tire building machine. From this process, The green tire comes from the combination of the carcass which consists of the inner layer and sidewall and the belt package with the help of pressurized air [7].

Figure 1.9 An example of green tire [7]

1.6.4 Curing

The green tire is cured using mold as shown in Figure 1.10 and specific heat, pressure and time which cause a vulcanization process making the tire components joined together. Besides, the tire has got its profile from the marking of the inner surface of the mold which will display on tire sidewall after this process [7].

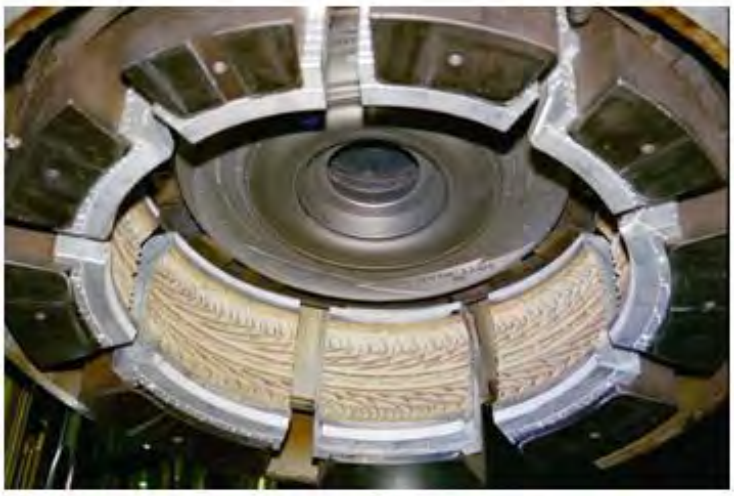


Figure 1.10 An example of mold which is used in curing process [7]

1.6.5 Quality Control

The quality check is the last process before sending tires to the customer. The quality checking is checked about tire appearance, properties and structures. The tire appearance is inspected by the manual process while the tire properties consisting of diameter, width and true run such as balance are inspected by machine-conducted sensory. The last checking is tire structures. The tire will be randomly inspected with X-ray to assure that the tire components are positioned correctly [7].

Chapter 2

Experimental

2.1 Quality management of Michelin Phra Pradaeng factory

2.1.1 Criteria of quality

Michelin uses the standard to classify the defect of after cure tires, which is called “File Tolerance Product (FTP)” to control the quality of tires. FTP has details about the method for classifying the tires. The inspectors will use FTP to divide the tires into groups according to their defects. As an example, Group A is the defect of contamination on the tire surface.

2.1.2 File Tolerance Product (FTP)

FTP or File Tolerance Product is a standard of classification which is used to classify the after cure tires that has the defect on them. FTP includes the group of defective tires called CQ. Each CQ consists of two parts: pictures and criteria

2.1.2.1 Pictures

The pictures in each CQ as shown in Figure 2.1 show the example pictures of each defect tire group to make the inspectors able to classify them with the correct criteria.

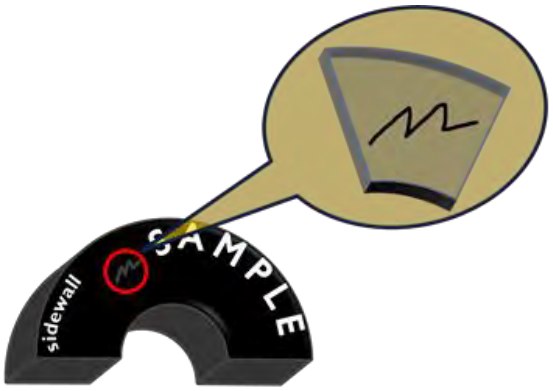


Figure 2.1 The example of picture in each defective group (CQ)

2.1.2.2 Criteria

The criteria are divided in 3 parts as shown in Figure 2.2

2.1.2.2.1 The measurement method

The measurement which is represented by the capital letter tells about the measurement method of after cure tire classification.

2.1.2.2.2 The range value

After the value is obtained from the measurement method. The range value which is represented by number is used to compare with the diagram to classify the tires.

2.1.2.2.3 The classification result

The classification results as shown in Figure 2.2 are divided into three types as follows:

1) Good

This “Good” classification result is shown with the green area in the diagram. The defective tire that match with good criteria of FTP will be sent to store at the warehouse to prepare for sending to the customers.

2) Rework

This “Rework” classification result is shown with the pink area in the diagram. The defective tire that match with rework criteria of FTP will be fixed at rework post by rework operators.

3) Scrap

This “Scrap” classification result is shown with the red area in the diagram. The defective tire that match or over the scrap criteria of FTP will be stored at scrap area with scrap label to prepare for further destruction.

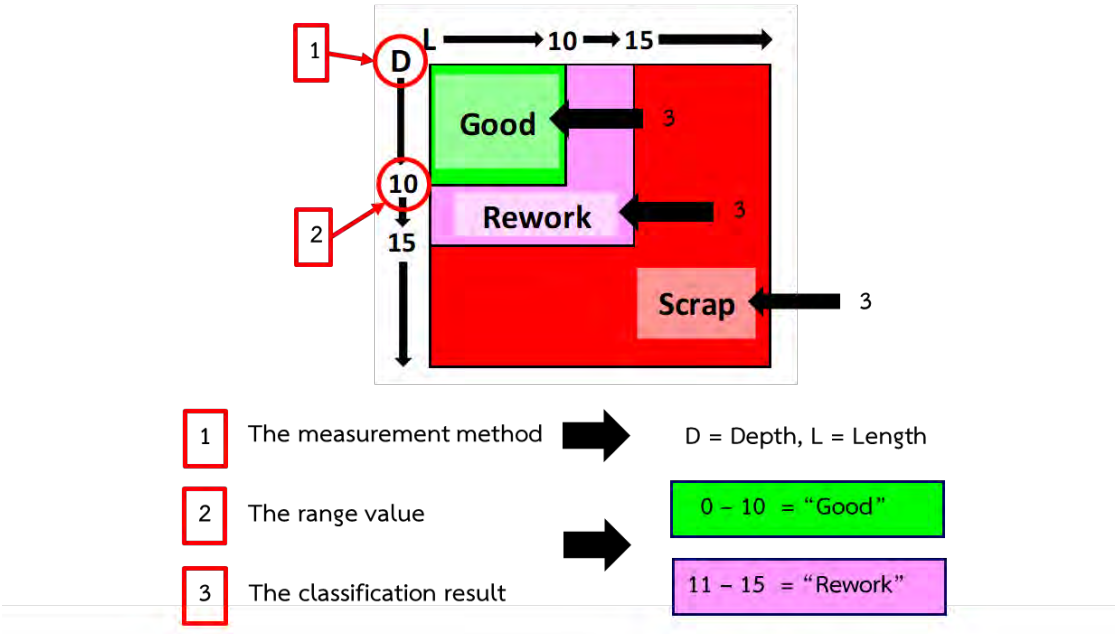


Figure 2.2 The example of the criteria in each defective group (CQ) of FTP

2.1.3 Final inspection process

In addition of the automative check which check the uniformity and weight of the after cure tires, Michelin Phra Pradaeng has the manual inspection which inspect the defect on every of after cure tires.

This process checks all after cure tires before delivery to the customers. This part consists of four main sections, namely Inspector post, Classify post, Rework post and Guarantee Quality control (GQC) section as shown in Figure 2.3.

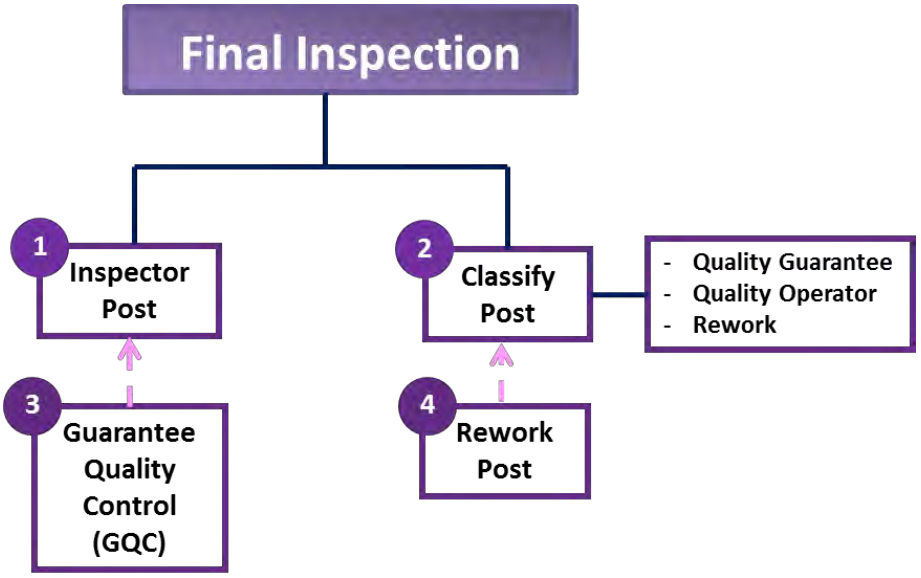


Figure 2.3 Four mains section in the final inspection. The pink arrows show relativity of each sections

2.1.3.1 Inspector post

The inspector post is the first post of this operation. The working process of inspectors is shown in Figure 2.4. The inspectors check tires and examine the defects. If the tires have defects, the inspectors will label the group of defects based on FTP on the tire surface. These data are collected using barcodes and divided into two cases as follows:

- Case 1:

The defective tires that match with the good criteria of FTP which will be stored at the warehouse for sending to the customers.

- Case 2:

The defective tires that do not match with the good criteria of FTP, which are called non-conform tires. The inspectors will then store the non-conform tires in non-conform area.

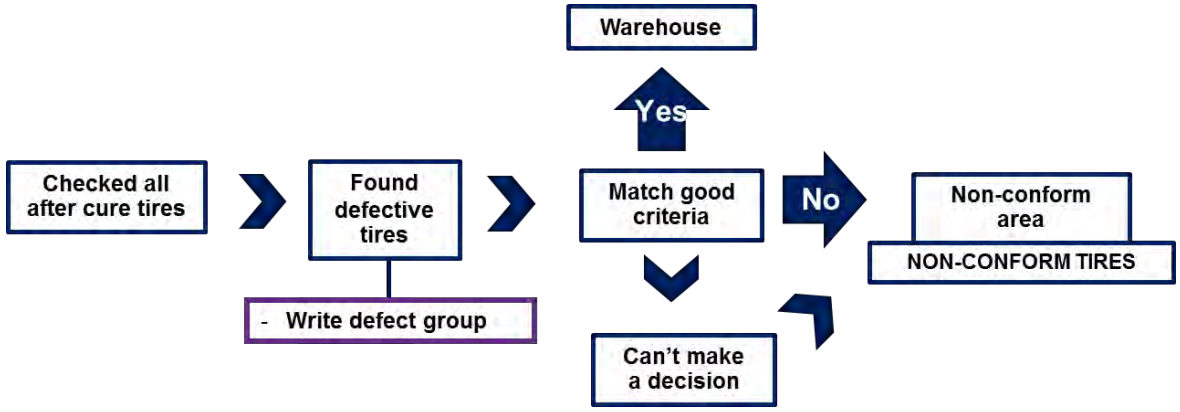


Figure 2.4 The working process of inspectors

2.1.3.2 Classify post

Classify post is divided into 2 parts as follows:

2.1.3.2.1 Classification of non-conform tires

The classify operators recheck non-conform tires which are classified from the inspectors, then divide them into two cases depending on the criteria of FTP as shown in Figure 2.5.

- Case 1:

If the non-conform tires match with the rework criteria of FTP, the classify operators will collect its data by barcodes and send them to rework post.

- Case 2:

If the non-conform tires do not match with the rework criteria of FTP or they cannot make a decision about some defective types, the classify operators will collect the data by barcodes and store the tires in scrap area and label them with the suspect tag.

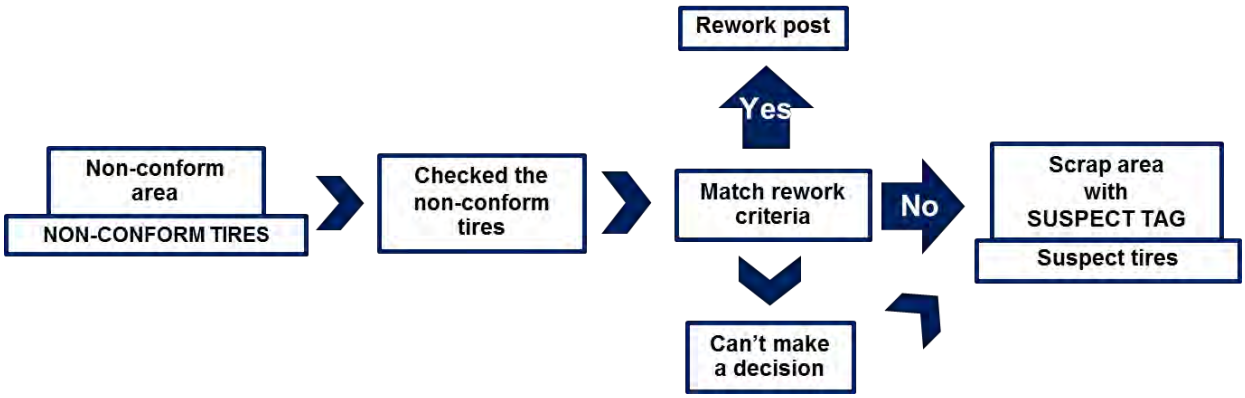


Figure 2.5 The classify operators working process

2.1.3.2.2 Re-classification of suspect tires

The expert team consists of the operators from three sections, namely Quality Guarantee (QG), Quality Operator (QO) and Rework. This team classifies the suspect tires in the final round and then, divides them into two cases (Figure 2.6) as follows:

- Case 1:

The suspect tires which are classified as scrap tires will be taken to scrap area with the scrap tag for further destruction.

- Case 2:

The suspect tires that can be reworked will be sent to the rework post.

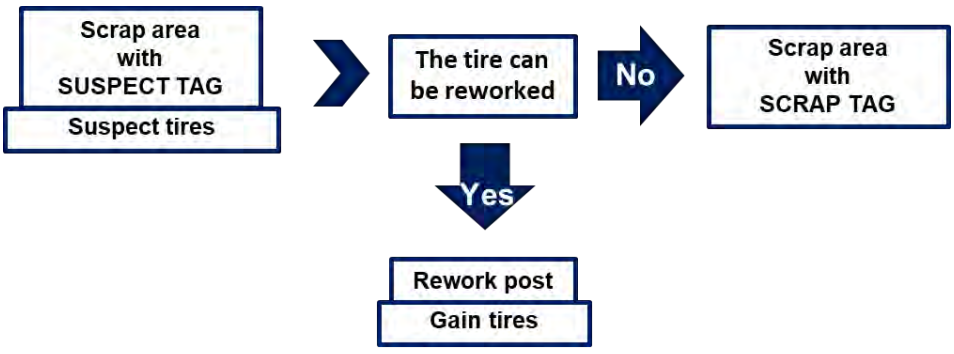


Figure 2.6 The re-classify process of Classify post

2.1.3.3 Rework post

Rework post is the process that the non-conform and suspect tires are fixed by the rework operators before sending them to the warehouse. The rework operators will fix the tires and collect the data of each tire using its barcode.

2.1.3.4 Guarantee Quality Control (GQC) section

This section sampling the tires checking by the inspectors to validate their accuracy about using the new FTP.

2.2 Gap analysis

The objective of this process is to compare the differences between current and new FTP. The comparison is divided into 2 parts

2.2.1 The amount of defective group (CQ)

The amount of current and new FTP are compared to study about the conversion of new FTP from current FTP that the amount of group in new FTP is increased or decreased comparing with current FTP.

2.2.2 The criteria of classification in each defective group (CQ)

The criteria of the same defective tire groups are compared between current and new FTP to consider whether its value is extended or reduced.

2.3 Impact analysis of new FTP

This objective of this process is to study about the impact of new FTP before implementing it in the factory. It consists of 3 steps as follows:

2.3.1 Implement current FTP and new FTP at Classify post

The current FTP and new FTP are applied in Classify post. In this step, two types of data are collected and consisted of the amount of gain tires from current and new FTP and the details of each defective group (CQ) to update new FTP.

2.3.1.1 Data collecting process

The table is designed in excel consisting of 6 topics: date, order, the defective group (CQ), barcode, the classification results of current and new FTP and remark as shown in Table 2.1.

Table 2.1 The example of record table for Classify post

Date	No	CQ	BARCODE	Classified by		Remark
				New FTP	Current FTP	
4-Sep-19	1	10	06789543	Good	Good	
4-Sep-19	2	10	96219932	Good	Good	
4-Sep-19	3	10	24898718	Good	Good	
4-Sep-19	4	20	18191911	Rework	Scrap	
4-Sep-19	5	20	15666442	Scrap	Scrap	
4-Sep-19	6	20	67562225	Rework	Rework	
4-Sep-19	7	80	67225664	Rework	Scrap	
4-Sep-19	8	10	24898720	Rework	Scrap	
4-Sep-19	9	20	18191916	Good	Good	
4-Sep-19	10	20	18191929	Good	Good	

In Classify post, If they found that the suspect tires can be classified as good and rework or found a problem with the new FTP, they will collect these details in remark column in the same row with tire barcode to gather the details.

2.3.1.2 Data evaluating process

The table is designed in excel and filled with the summary from data recording table. It consists of 5 topics: date, a total amount of suspect tires, the amount of gain tires from current and new FTP, gain percentage from current and new FTP and the gain percentage comparison between current and new FTP as shown in Table 2.3.1.2. For the percentage column, the formulation to calculate these percentage is created as shown in Figures 2.7 - 2.9.

$$\%\text{Gain from current FTP} = \frac{\text{The amount of gain tires classified by current FTP}}{\text{Total amount of suspect tires}} \times 100$$

Figure 2.7 The formulation to calculate gain percentage from current FTP

$$\%\text{Gain from new FTP} = \frac{\text{The amount of gain tires classified by new FTP}}{\text{Total amount of suspect tires}} \times 100$$

Figure 2.8 The formulation to calculate gain percentage from new FTP

$$\%\text{Gain Comparison} = \%\text{Gain from new FTP} - \%\text{Gain from current FTP}$$

Figure 2.9 The formulation to calculate gain percentage comparison between current and new FTP

Table 2.2 The example of evaluating table

Date	Total suspect tires	Gain tires classified by		%Gain from		%Gain comparison
		Current FTP	New FTP	Current FTP	New FTP	
1-Aug	50	5	9	10%	18%	8%
2-Aug	46	12	15	26%	33%	7%
3-Aug	28	3	7	11%	25%	14%
4-Aug	17	1	5	6%	29%	24%
5-Aug	39	5	6	13%	15%	3%
6-Aug	43	9	11	21%	26%	5%
7-Aug	27	3	6	11%	22%	11%
8-Aug	12	0	2	0%	17%	17%
9-Aug	41	6	8	15%	20%	5%
10-Aug	35	7	13	20%	37%	17%
11-Aug	31	4	5	13%	16%	3%

For this data evaluating process, the amount of gain tires which is classified by current and new FTP are counted with manual process. The classification results which are counted as amount of gain tires is good and rework. Then, the gain percentage will be calculated by the formulation as showing above. For example, when the amount of gain tires which is classified by new and current FTP from Table 2.1 are counted, the value is 9 and 6 respectively.

2.3.2 Clarify details of new FTP

This step uses data from 2 sources: (1) Data from the remark and the defective group (CQ) column of data recording table, (2) Data form the discussion of the team of Michelin Phra Pradaeng consisting of Quality Guarantee section, Shop trainer and production team.

These data is analyzed and used to adjust new FTP. Then, this new FTP is sent to Michelin central team to do the closed-loop and to create the completed new FTP is created.

2.3.3 Completed new FTP

The completed new FTP is created from the previous process and prepared for implement action in the factory instead of current FTP.

2.4 Training the inspectors

Before implementing new FTP in the factory, the inspectors are trained by Quality Guarantee Product (QGP) operators to make them understand about new FTP and able to use new FTP efficiently. QGP operators set the schedule and communicate to inspectors. The list of all inspectors is created to check their attendance. After the training, 100 percentage of inspectors are trained by QGP operators and QGP operators have coached them at their post.

2.5 Validating after implementing the completed new FTP

After training the inspectors were trained by Quality Guarantee Product (QGP) operators from the previous step and new FTP was initially implemented in the factory, the validating process is required to check whether the inspectors understand new FTP. The inspectors are validated by the Guarantee Quality Control (GQC) section, which samples their classification results to make sure that they can use new FTP correctly.

2.5.1 Data recording process by Guarantee Quality Control (GQC) section

The Guarantee Quality Control (GQC) section checks the tires which is classified by the inspectors. The data recording table as shown in Table 2.3 is designed in excel consisting of six topics: order, barcode, the defective group (CQ), the classification result from Guarantee Quality Control (GQC) operators, the classification result from inspectors and the number of inspectors.

Table 2.3 The example table of data recording process by Guarantee Quality Control (GQC) section

No.	Barcode	CQ	Classified by GQC	Classified by inspector	Inspector No.
1	49230023	10	Good	Good	4531
2	29409409	12	Good	Good	4134
3	74768875	40	Good	Good	4587
4	21321321	40	Good	Good	4531
5	34265252	60	Good	Good	4531
6	89564633	60	Good	Good	4587
7	67586787	70	Good	Good	4531
8	34534535	70	Good	Good	4587
9	00432452	80	Good	Good	4134
10	02446994	90	Rework	Good	4134

2.5.2 Confirmed by the Quality Guarantee Product (QGP) operators

The Quality Guarantee Product (QGP) operators check tires which is classified by the Guarantee Quality Control (GQC) section. The “confirmed by QGP” column is added in the table form data recording process by Guarantee Quality Control (GQC) section as shown in Table 2.4.

Table 2.4 The example table of confirmed by the Quality Guarantee Product (QGP) operators

No.	Barcode	CQ	Classified by GQC	Classified by inspector	Inspector No.	Confirmed by QGP
1	49230023	10	Good	Good	4531	CONFORM
2	29409409	12	Good	Good	4134	CONFORM
3	74768875	40	Good	Good	4587	CONFORM
4	21321321	40	Good	Good	4531	CONFORM
5	34265252	60	Good	Good	4531	CONFORM
6	89564633	60	Good	Good	4587	CONFORM
7	67586787	70	Good	Good	4531	CONFORM
8	34534535	70	Good	Good	4587	CONFORM
9	00432452	80	Good	Good	4134	CONFORM
10	02446994	90	Rework	Good	4134	GAP

The results of the confirmation can be divided into 2 cases:

- Case 1:

If the classification result of GQC operators and inspectors are similar, the QGP operators will fill the confirmed column with “conform”.

- Case 2:

If the classification result of GQC operators and inspectors are different, the QGP operators will fill the confirmed column with “gap”.

The objective of this process is to check the inspector understanding of using the new FTP. This is the reason that the table has the inspector number, because when they have gap of classification, the QGP operators can go to talk and coach them to correct that point.

Chapter 3

Results and discussion

3.1 Gap analysis

The result of the comparison is divided into 2 parts as follows:

3.1.1 The amount of defective group (CQ)

The amount of CQ in new FTP is decreased compared with current FTP, because some of current FTP which use the same criteria is canceled and combined together. However, although the amount of new FTP is decreased, some criteria are added to make sure that the tire quality can compete in the current market and respond to the customer satisfaction.

3.1.2 The criteria of classification in each defective group (CQ)

The criteria are represented by diagram. The instruction of new FTP is simplified and the range value is extended compared with current FTP as shown in the blue area (Figure 3.1), because of the development of rework methods and more experiences of the rework operators.

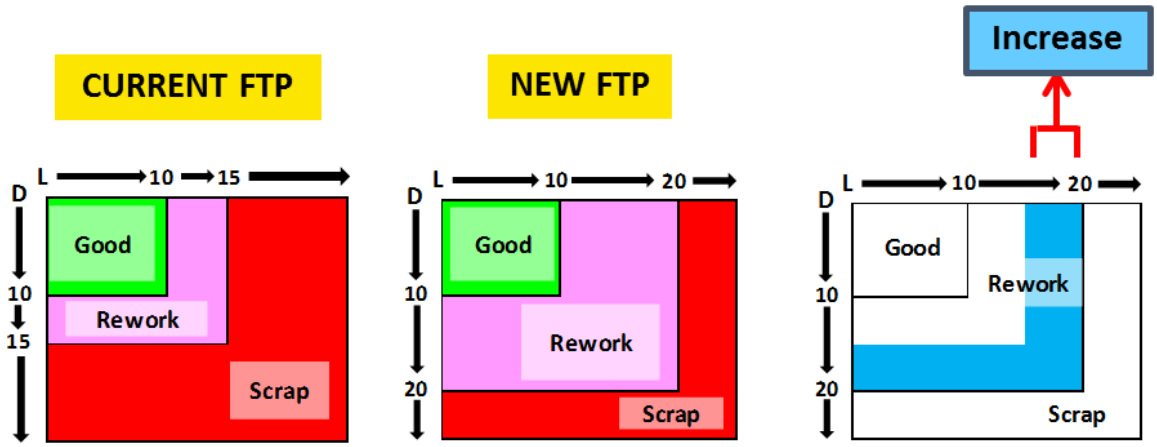


Figure 3.1 The example diagram of current and new FTP, the blue area is shown the extended of range value

3.2 Impact analysis of new FTP

The result of the impact analysis is divided into 2 parts as follows:

3.2.1 The amount of gain tires from current and new FTP

The overall of gain percentage and gain percentage comparison from current FTP and new FTP is shown in Table 3.1.

Table 3.1 The overall of gain percentage and gain percentage comparison between current and new FTP

Months	%Gain from		%Gain comparison
	New FTP	Current FTP	
JULY	23%	12%	11%
AUGUST	26%	21%	5%
SEPTEMBER	23%	14%	9%
Total	24%	16%	8%

From Table 3.1, the gain percentage comparison of July, August and September are 11, 5 and 9 respectively and when the gain percentage comparison of overall is focused, It is equal to 8 which is still a large value. The bar graph as shown in Figure 3.2 represented the gain percentage comparison of current and new FTP.

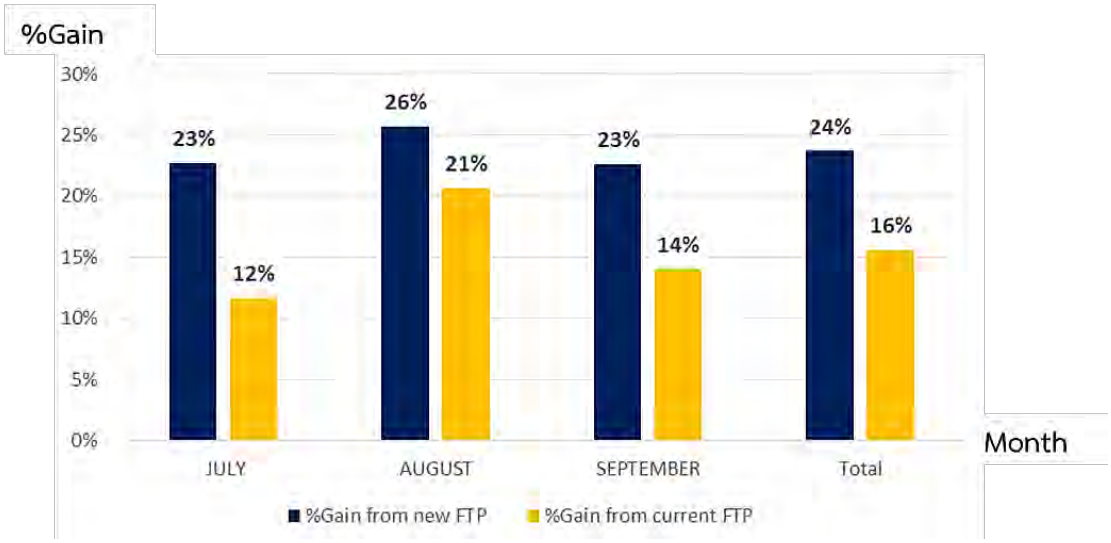


Figure 3.2 The gain percentage comparison of current and new FTP

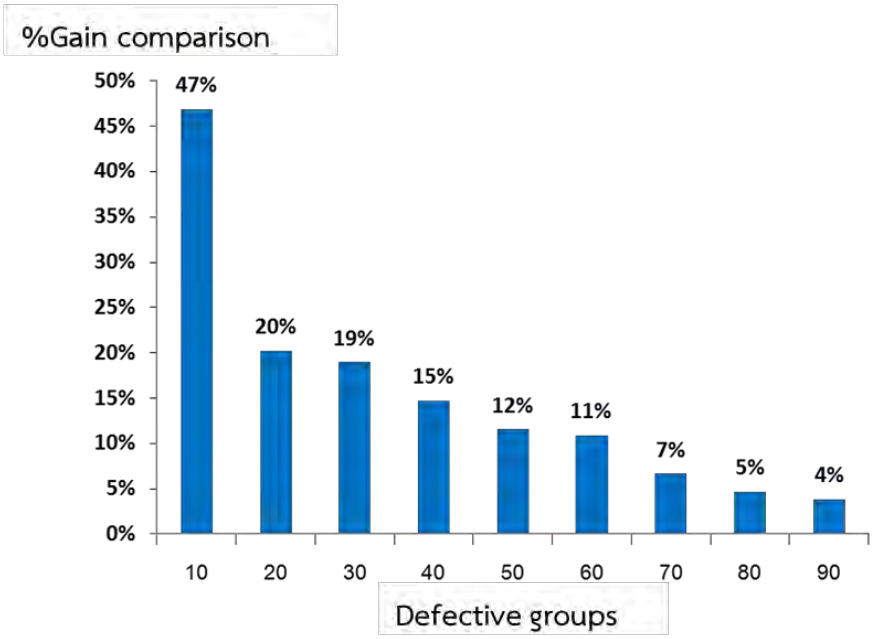


Figure 3.3 The pareto chart of the top 9 defective groups (CQ) of the gain percentage comparison

From the pareto chart shown in Figure 3.3, the maximum of gain percentage comparison is equal to 47, which means when the completed new FTP is implemented the gain tires of this defective group is increased in a large value.

3.2.2 Clarify details to update new FTP

The pictures and descriptions are added to new FTP to make it easier to understand and correct some of difficult points from the details, which are obtained from 2 sources: Data recording table at Classify post and discussion with team and then the updated new FTP is created. After that, the updated new FTP is sent to discuss with the Michelin central to do closed-loop and finally, the completed new FTP is created.

3.3 Training the inspectors

After the completed new FTP is created, the inspectors are trained by Quality Guarantee Product (QGP) operators as shown in Figure 3.4. The attendance list shows that all of inspectors are attended to train this completed new FTP.

Figure 3.4 The picture while training the inspectors

3.4 Validating after implement the completed new FTP

The classification results of using completed new FTP from the inspectors are validated by Guarantee Quality Control (GQC) section and confirmed by Quality Guarantee Product (QGP) operators. In the early period of implementing the completed new FTP (Figure 3.5), there are still some gap but after that it is decreased which mean after the coaching and explanation about the new FTP to inspectors who do not understand some points, they can use the completed new FTP more correctly compared with the beginning. Thus, this process is effective.

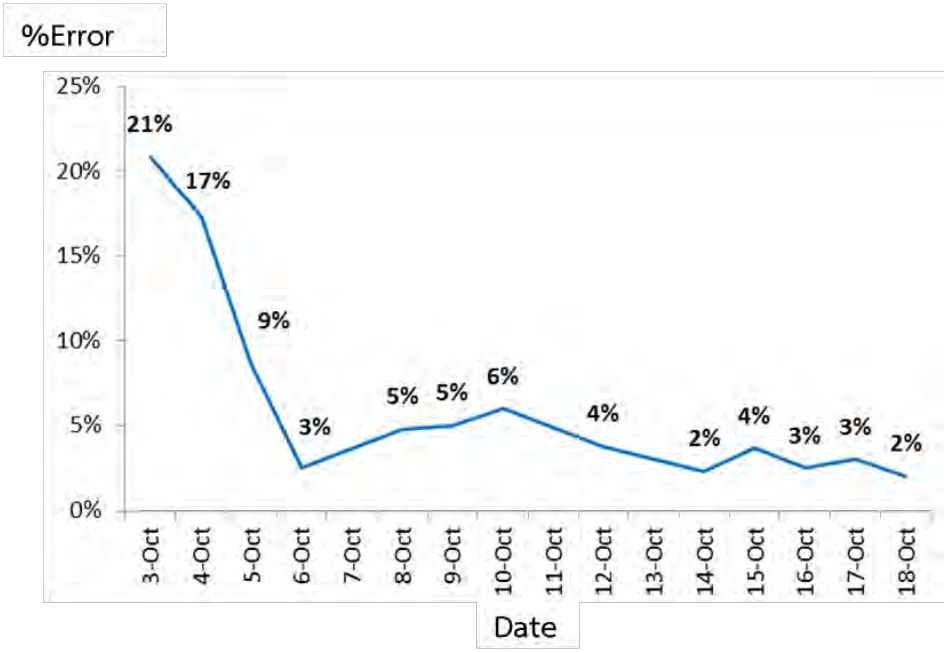


Figure 3.5 Error percentage from the classification results of using completed new FTP from the inspectors

Chapter 4

Conclusion

4.1 Conclusion

The completed new FTP provided more advantages over current FTP in terms of quality, simplification and gain percentage comparison because completed new FTP updated in the defective groups (CQ) which can respond to the customer satisfaction. It is also added with pictures and descriptions and the range value of the same defective group as current FTP is extended.

4.2 Obtained benefits

The completed new FTP can be used in the factory instead of current FTP without impacting the after cure tire classification process.

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VITA

Ms. Artima Lairattanakul was born on August 2, 1998 in Bangkok, Thailand. She graduated from the Bodindecha (Sing Singhaseni) School, Bangkok in academic year 2015. She studied in Bachelor of Science degree at Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok, Thailand. Her current address is 805/44, Soi Tessabanbangpoo 59/2, Tambon Taibanmai, Samutprakan, 10280 and an e-mail is mildarti@gmail.com