ABSTRACT

In Sipro Plastic Industries Sdn. Bhd., their main production is to produce product cover door outside handle, Rh (Keyless). The company had reported poor quality of particular products, by using direct injection moulding machine. This is because the quality always one of importance issue in manufacturing industry. This study was conducted to analyse various factors of defects in injection moulding process of the production line of manufacturing organization. Based on some reading material such as journal, book and some study state that some factors such as machine, human, mould, method, technology and material caused defects in injection moulding process. This research focusing on production line which includes the machine, mould, operator, identify the defect rate and causes that lead to the defect occur. The main objective of this research is to identify the major defect, investigate the causes of major types of defect and recommend the improvement plan to reduce defect rate for product cover door outside handle, Rh (Keyless) using injection moulding operation. 7 tools of quality will be used to identify the major types of defect. Cause and Effect Diagram also will be used to investigate the cause of defect. An interview will be conducted with production line and several departments manager to have some discussion and observation about the study. From the result of this paper machine and manufacturing process selection is very important to produce product cover door outside handle, Rh (Keyless). The best method and technique to produce cover door outside handle is by using injection moulding which control the screw and barrel cleaning, purging of screw and barrel, dry temperature and time, control barrel temperature and high barrel temperature. The result of data analysis and comparison between past rejection data report result and research result show that all three major defects can be reduce by controlled the screw and barrel cleaning, purging of screw and barrel, dry temperature time, control barrel temperature and high barrel temperature.

Keywords: injection moulding, types of defect, 7 tools of quality
competitiveness, higher customer loyalty, and lower costs are leading to get high quality products.

The costs occurred from providing high quality products or services are lower than the costs affected by the low quality products or services was mention Crosby (1996), because the cost of poor quality is scrap, rework and retest. That is more than the cost of doing it right the first time.

Costs of poor quality can be categorized into four categories: prevention costs, appraisal costs, failure cost (internal failure costs and external failure costs) and an intangible cost was said Summers (2003). The major subcategories of internal failure costs are scrap, rework, retest, failure analysis, downtime, and downgrading. Subcategories of external failure costs are complaint adjustment, returned product and material, warranty charges, liability costs and indirect cost.

Competitors are not only from domestic companies but also from international companies Seymour (1994). Therefore, customers have the right to choose companies that can satisfy their needs the best. Examples of customer needs are high quality products, low prices, fast delivery, good services, etc. Continuous Improvement Theory (CIT) is one of the strategies that can help organizations to satisfy customer needs and help organizations to have greater performance. Sipro Plastics Company Sdn. Bhd. is core business is offering injection moulding solutions to reach customer demands. They provide injection moulding in the fields of appliance. Quality of plastic parts and customer service has been the focus of the company to gain market share and to satisfy their customers.

The company's business has been increased dramatically within the past couple years. This company is producing a larger variety of injection moulding products than before. Some products are produced often or seasonally, but some products are produced just one or two times. They do have not enough time to making experiment before producing to attain suitable settings for each product like they had in the past. New employees, which were hired to support the growing business, were lacking quality knowledge of material product characteristics. This affected the product quality, increased both internal and external failure cost, and increased customer complaints.

1.2 Problem Statement

Car has become necessities to people nowadays. People often use it for transportation to go anyway. For maintaining the customer loyalty and satisfaction, company have to maintain their quality of product. Manufacturing car should be aware about the product produce. In injection moulding of car part, several defects often occur. For example, silver streak, flow mark, and black dot. These types of defect will affect most on quality of product.

As the defects will decrease the quality of product, the customer satisfaction will also decrease. This will affect most on company image and lead to loss in profit. The company should find some solution to overcome this problem. If not, company is at risk and lost the customer loyalty. To improve the quality of product, the whole organization should work together and help each other to reduce defect rate.

From the collected reject data from August until October 2016, its found has 3 major defects such as silver streak, flow mark, and black dot. Defect rate quantity was increased for every month. This is the problem in this company. It is important to identify the method to reduce rate of product reject.
1.3 Objective

The objectives of the project are:

(i) To identify types of defect on Cover Door Outside Handle, Rh (Keyless) moulding operation.
(ii) To investigate the causes of major types of defects.
(iii) To recommend the improvement plan to reduce defect rate.

2. LITERATURE REVIEW

This segment is present about literature review concepts of quality including 7 tools of quality, Six sigma, and Poka-Yoke method. Moreover, this segment is devoted to the review of literature which includes the concept of injection moulding and processing.

This research also represents theoretical of injection moulding and 7 tools of quality on journal. Literature review shows the process of reading, analysing, evaluating, and summarizing scholarly materials about a defects reduction, and all methods that able to reduce defective. The results of a literature review may be compiled in a report or may serve as part of a research article, thesis, or grant proposal.

The 7 tools of quality are used for improving processes, identifying problems, seeking root causes of problems, and solving problems. These tools are incredibly simple so all levels of workers can use them easily. The 7 tools of quality can be applied together with the PDSA cycle to help the process progress more rapidly and systematically. The 7 tools of quality consist of cause-and-effect diagrams, flowcharts, histograms, Pareto diagrams, check sheets, control charts, and scatter diagrams Benbow, Berger, Elshennawy & Walker (2002).

3. METHODOLOGY

This research was discuss briefly about techniques used in identifying the general and major problem of defect rate occurs. 7 Tools of Quality is the method for identifying the major defect and how to reduce the defect.

3.1 Observation using Validation Process

Through observation, the specific problem of the department can be understood. Normally the observation period is within one to two hours per day by using the Validation Process. The study quality process for this research was based on direct observation to manpower for determining the problem when production running. That is, to determine either manpower or machine is the problem and to propose an ideal improvement for the flow process of production and quality product in injection moulding at Sipro Plastic Industries SDN. BHD.

Besides that, this research was based on analysing the injection moulding process from incoming material until producing the product. The company used many materials for making the product such as Acrylonitrile Butadiene Styrene (ABS), Polypropylene (PP), Polycarbonate (PC) and etc.
3.2 Past Rejection Data Using Moulding Daily Report

Past rejection data from the moulding section to find out where the rejection occur. Data such as the actual time of each activity was carried out, the number of rejected items, the targeted value of each day and actual quantity production was taken. Thus the problem based on the data can be identified and then analysed to determine where the actual problem.

This research was based on collected data of defects for 3 months from August 2016 until October 2016 in Table 1 and Graph 1 shows the total quantity against reject rate. This company facing many defects for example in Table 2 and Graph 2 show the type of defect against quantity. From the data, it found the 3 major type of defects such as a black dot, silver streak, and flow mark. It focuses on the major defects only for reducing the defect and will increase the quality product.

**Graph 1: Defect rate in 3 months**

![Graph 1: Defect rate in 3 months](image)

<table>
<thead>
<tr>
<th>MONTH</th>
<th>TOTAL QTY</th>
<th>REJECT RATE</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUGUST</td>
<td>3522</td>
<td>437</td>
<td>12.41%</td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>14178</td>
<td>1869</td>
<td>13.18%</td>
</tr>
<tr>
<td>OCTOBER</td>
<td>12242</td>
<td>2321</td>
<td>18.96%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>29942</td>
<td>4627</td>
<td>44.55%</td>
</tr>
</tbody>
</table>

**Table 1: Defect rate in 3 months**

<table>
<thead>
<tr>
<th>COVER DOOR OUTSIDE HANDLE, RH (KEYLESS) (D63D)</th>
<th>MONTH</th>
<th>TOTAL QTY</th>
<th>REJECT RATE</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AUGUST</td>
<td>3522</td>
<td>437</td>
<td>12.41%</td>
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<td>TOTAL</td>
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<td>4627</td>
<td>44.55%</td>
</tr>
</tbody>
</table>
3.3 Pareto Chart

A Pareto diagram is used to identify the major problems or causes in the process. It is a histogram which is sorted from the highest frequency to the lowest rejection rate. The 80/20 rule uses a Pareto diagram to identify roughly 80% of problems created by 20% of factors. Therefore, it will recognize which major defect should be solved first and which one can be solved later. Following are six steps to create a Pareto diagram:

(i) Determine the rejection data to be collected.
(ii) Determine the type of defect to be used.
(iii) Collect and record data.
(iv) Rank orders the defect of data.
(v) Prepare the graph.
(vi) Calculate and place on the graph a relative frequency line above the defect data

3.4 Cause and Effect Diagram

In order to determine the exact and most likely causes of major defects, a brainstorming section was carried out with the Quality Assurance Engineer and Technical Engineer in production operation. Through the brainstorming section, all possible major causes were listed in the cause and effect diagram. The causes are grouped into categories which are convenient for users to focus on.

4. RESULT AND DISCUSSION

Graph 3 explains that black dot, silver streak, and flow mark defect are the major contributor for the rejection rate for the 3 month which contributes almost 44% average of the total rejects compared to other defects. 3 major defects are more critical to focus for improved the quality between other than defects.

Graph 3: Pareto Chart for Defects
Investigate the problem using Cause and Effect Diagram by each major defects

In order to determine the exact and most likely causes of major defects, a brainstorming section was carried out with the Quality Assurance Engineer and Technical Engineer in production operation. Through the brainstorming section, all possible major causes were listed in the cause and effect diagram.
Figure 1: Cause and Effect Diagram for Black Dot Defect.

Figure 2: Cause and Effect Diagram for Silver Streak Defect.

Figure 3: Cause and Effect Diagram for Flow Mark Defect.
4.1 Improving the Major Defect

After collecting and analysing the data, the identified defect was the 3 major defects which caused the major quality problem in the 280 tone injection moulding line. Cause and effect diagram was also drawn to identify the causes of major defects. From here three suggestions was recommended to reduce the defects. The suggestions were:
(i) Screw and barrel cleaning – Black Dot
(ii) Dry material and control temperature barrel – Silver Streak
(iii) High barrel temperature – flow mark

4.2 Comparison before and after Implementation

Based on Table 4, the percentage average of major defects is decreased more than 5% between before and after implementation. For example, previous data for the black dot defect is 40.1% while, after cleaning barrel implemented to reduce the defect, the result is 37.9%

Table 4: Comparison Data

<table>
<thead>
<tr>
<th>NO</th>
<th>MAJOR DEFECT</th>
<th>BEFORE</th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BLACK DOT</td>
<td>40.1%</td>
<td>37.9%</td>
</tr>
<tr>
<td>2</td>
<td>SILVER STREAK</td>
<td>27.5%</td>
<td>24.9%</td>
</tr>
<tr>
<td>3</td>
<td>FLOW</td>
<td>16.3%</td>
<td>14.7%</td>
</tr>
</tbody>
</table>

5. CONCLUSION

From a study, to apply the 7 Tools of Quality methodology in a Sipro Plastic Industries SDN BHD company were achieved. The suggestion for improvement was done on 280 tone injection moulding production department. The quality problem in this department was analysed using 7 tools of Quality methodology. Pareto chart is one of the 7 tools of the quality method to identifying the major types of defect. After collecting the past data, it found that the 3 major defects are the black dot, silver streak, and flow mark. From the investigation the cause of the defect using cause and effect diagram for the black dot, silver streak, and flow mark defect had been successfully determined such as barrel cleaning, dry material and control temperature, and high barrel temperature. According to previous defected from
injection moulding, most 30 types of defects. After implementing the suggestion to reduce the defect, some recommended to control the defect in injection moulding. The findings from this project can be used as a guide to improve other quality problems.

REFERENCES


